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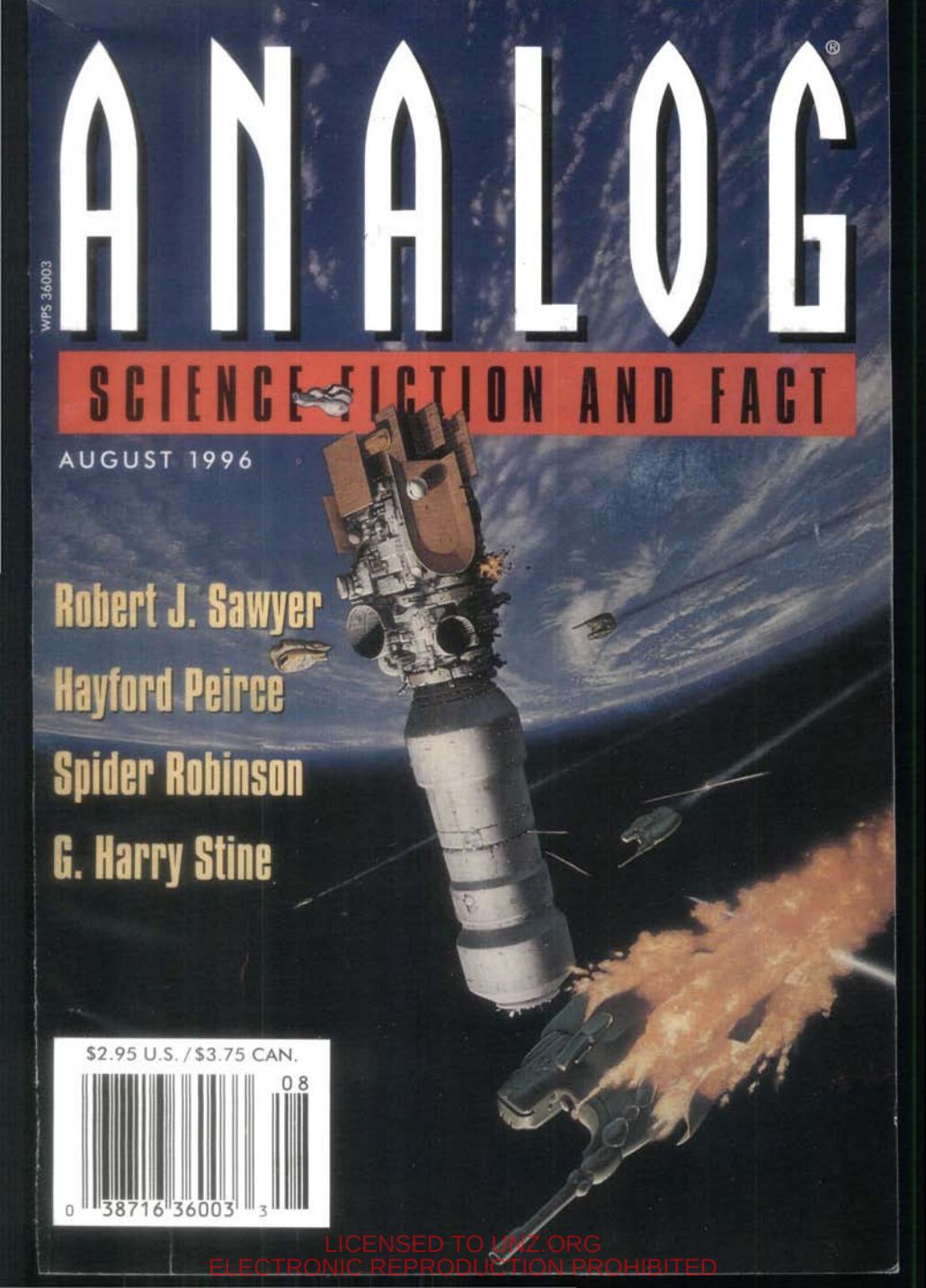

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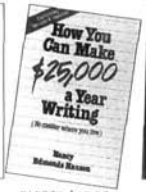

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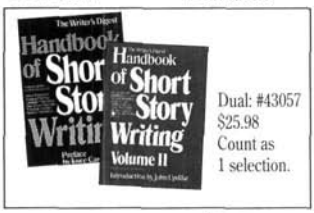

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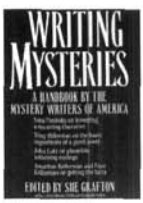

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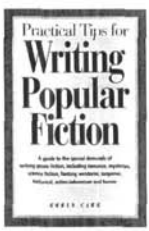

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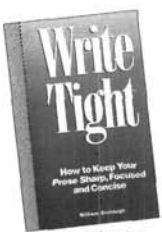

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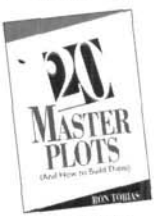

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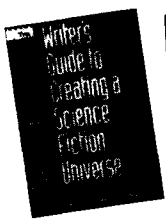

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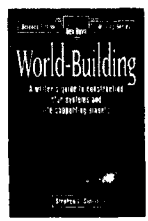

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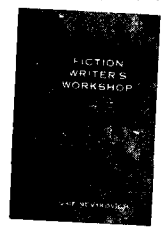

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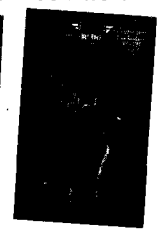
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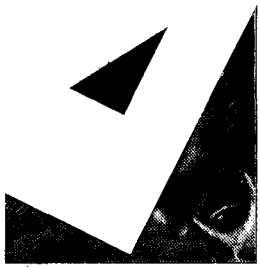

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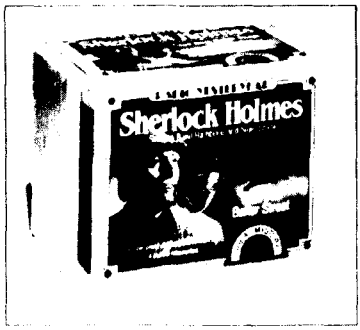

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EDITORIAL Stanley Schmidt

THE OTHER SIDE OF BORDERLESS

One of the qualities many people find appealing about the Internet and its various appendages is the way it transcends national borders. It's not uncommon for an on-line discussion to be joined by people literally all over the world. Getting the same effect through other media, such as mail or telephone, would usually be prohibitively cumbersome, expensive, or both.

The ability to converse casually with people in many other countries offers many potential benefits. Want to know what people eat for breakfast in Bulgaria? You *might* be able to track down an answer through reference books, but you can probably get it a lot faster—and ask further questions as they occur to you—by simply asking somebody who lives there. Don't know anybody who lives there? No problem: post a query on an electronic bulletin board. It probably won't be long before somebody notices and offers you an answer.

You may not care about Bulgarian breakfasts, but writers often need to know about obscure little details like that. If you're not a writer, there are very likely other things you're curious about that could be most easily answered by somebody in another country. Even if you can't think of any, you might find a question posted that *you* can answer for someone elsewhere. The ensuing dialog might lead both of you to ask questions about each other's lives and surroundings. Such give and take, multiplied by many such exchanges, could easily lead to dramatically increased understanding between geographically separated peoples, and thereby make an important contribution to world peace.

However, at least one recent incident suggests another, darker side of borderlessness. The specific problem may have been resolved by the time you read this, but the issue it exemplifies will still be worth talking and thinking about. The incident that we've all read about is only one illustration of what can happen, and it would be naïve to assume it will be the last.

As I write this, news media (as well as the Internet itself) have been full of

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discussion of a demand by a country's government that a major on-line service not provide its citizens access to some portions of the Internet on the grounds that they were pornographic under that country's laws. The on-line service, having no ready way to block access only within a single country, responded by blocking access to the offending material for *all* its subscribers—everywhere. Thus what some four million subscribers, scattered around the world, could see was being determined by the laws of a single country containing fewer than 6% of those subscribers.

Many net enthusiasts, already concerned about on-line censorship, were quick to attack this as one of the most blatant examples yet. They're right, but its real significance is even bigger. It is not, as one Associated Press article said, that the incident "suggested that the Internet may not be the borderless technology many had hoped it would be." Quite the contrary. It suggests that the Internet may provide a new and dangerous way that *governmental power* in matters which have always been considered purely internal affairs, can creep across borders into other countries.

Whether or not the material in question is actually pornographic, by anybody's standards, is not the issue. The fact that the country involved was Germany, and the on-line service was CompuServe, is not the issue. The issue is that the sequence of actions—the government's demand and the on-line service's response—sets the precedent of *any* country being able to dictate what goes on in any other. The real danger here lies in the fact that the government of Germany was telling people who didn't live in Germany that they couldn't see things that weren't produced in Germany. If that doesn't make you uncomfortable, try substituting some other countries' names in there. I'm reasonably confident that, no matter where you live, you'll find some possibilities that raise your hackles.

You might argue that the on-line service must share the blame in such a case: it didn't *have* to comply with the demand. Indeed, one CompuServe spokesman was quoted as saying of their response, "It may be an overreaction, but we want to cooperate with the Bavarian prosecutor's office." The alternative might be to lose all 220,000 German subscribers, which would not only hurt CompuServe economically, but would de-

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prive all those customers of all the services they subscribed for. Businesses *do* have to try to satisfy their customers and comply with the laws of all the places in which they operate. But when a company operates in many countries, trying to satisfy each of them by imposing the restrictions *it* wants on *all* countries is a dangerous course, both politically and economically.

I think CompuServe understands this, and realizes that what it did is not a satisfactory long-term solution (But subscribers who feel that way should not hesitate to remind them until a better way is found!). The service's public statements at the time said it imposed the systemwide blockage on news groups considered pornographic by Germany (an important customer nation) because it was the only available way to comply *promptly* with those laws. It indicated that it plans to develop technological means of keeping certain material out of one country without blocking all. There's no technological reason why it can't, and all of us should insist on it. Otherwise we will all be at the mercy of everybody else.

If on-line services follow through on plans to develop means to make what they supply to one country comply with its special requirements without compromising what they supply to others, the danger may be temporary. Probably some consideration should also be given to the suggestion that if any country wants to block material that is widely accepted elsewhere, it's up to *them* to provide the means to do so.

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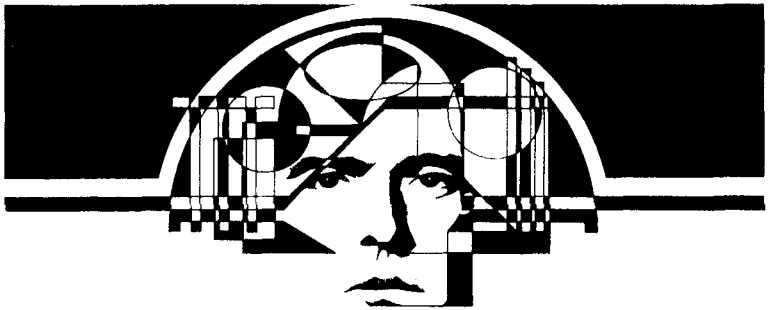
Either way is a faintly disturbing compromise in that it will, to some extent, erode the "borderless" character of the net. But now that we've seen the other side of that, it may turn out that as long as nations have borders, we *need* at least some kinds even on the net—if only to keep governments from getting out of hand and into other nations' affairs.

On the other hand, looking farther ahead, might there be a bright side to the occurrence of this kind of conflict? Net users who've experienced freedom from borders and the benefits it can bring might grow increasingly impatient with meddling by their own or other governments. Might public demand eventually lead to the erosion of unnecessary borders at all levels?

We shall see. ■



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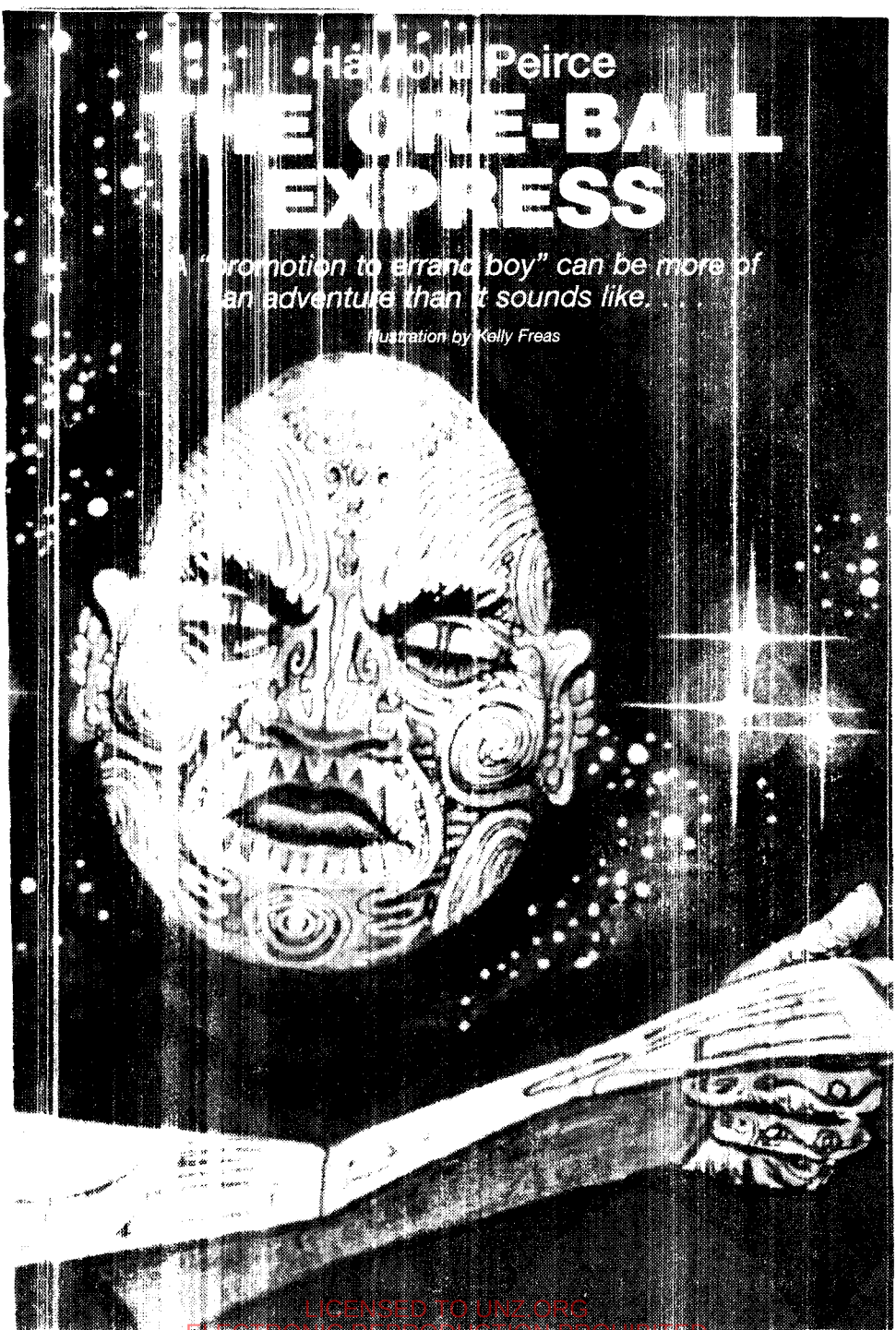

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"You're fired!"

I'd heard J. Davis Alexander scream those words so often that I no longer paid any attention to them. So now I jumped hardly more than two meters in the 4 percent Cerean gravity, saving my head from a painful collision with the ceiling only by hooking my toes under the edge of my desk at the very last moment. Cursing myself for not always using the footbar beneath the desk, I slowly subsided into my chair while pondering the ominous words. *Now* what had I done to—

It was only when I heard the equally enraged screams of J. Davis Alexander's benighted nephew emanating from the office where the lord and master of Hartman, Bemis & Choupette presided over the fortunes of the largest brokerage house in Ceres, that I realized that for once it was not the neck of Jonathan Welbrook White that was getting the chop.

Could it really be the obnoxious Hooten Delahooty who had finally strained his equally obnoxious uncle's patience to the breaking point?

Apparently yes. "—Latest idiocy has cost us 217,000 Belter buckles," came J. Davis Alexander's anguished voice, "not to mention the dozens of clients you've driven away since I was stupid enough to hire you and your equally idiotic twin brother. Horton's already gone, thank God! Now *you* have fifteen minutes to gather your affairs and get out of my life forever!"

Melodramatic, of course, but when you're dealing with someone as intrinsically lazy, stupid, and dishonest as Hooten Delahooty had proven himself to be in the three years he had gone through the motions of pretending to be an ethical broker & bourseman, a certain amount of pyrotechnics is sometimes necessary to get your message across.

After a few more shrieks of heartfelt fury by each of the parties concerned, I caught a brief glimpse of Hooten's skinny frame streaking past the door of my modest cubicle on his way, I hoped, to the far more imposing door that led to the outer world. As much as I normally commiserated with all the other unfortunates constrained to slave for J. Davis Alexander, I could hardly contain my relief at finally being rid of his loutish nephew. Three years of—

"White!" My reveries were interrupted by J. Davis Alexander in full voice. "Get in here at once!"

The manager of Hartman, Bemis & Choupette had a fine corner office overlooking Clarkeville's choicest piece of prime real estate, Westlake Park. Twenty meters above the park's celebrated duck pond, we were another 20 meters below the realistic-looking blue and white sky that hid the carbonaceous chondrite rock ceiling separating our town and its 300,000 underground inhabitants from the hard vacuum of Ceres's surface. As I half-bounced, half-floated into J. Davis Alexander's office I caught a glimpse of a family of ducklings practicing their landings in the middle of the pond.

"White," growled J. Davis Alexander, "I've just fired that idiot Hooten for pure, unmitigated incompetence.

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Let that be a lesson—*you* could be next."

I nodded, trying to keep my eyes focused on a spot just beyond his left shoulder. Unlike most Belters, who are long and lean in our almost nonexistent gravity, J. Davis Alexander was round and short and as hairy as a wolverine—with a disposition to match. For reasons of ideology or religion his parents had refused to give him his gravity pills during his childhood years. The result was the unpleasant spectacle that I was trying to avoid looking at.

"Now, then," continued J. Davis Alexander, squinting at me fiercely with his baleful black eyes, "for all your faults, White, I have to reluctantly concede that you're the least incompetent of all the many incompetents I'm burdened with. I'm therefore giving you a bonus: I'm turning over all the accounts my worthless nephew was supposed to be handling. Naturally, this means we'll have to reduce your commission on all your other accounts, but overall your income will increase to—"

"Then fire me before I quit," I said, glancing at the appointment schedule on my wristwatch. "Hooten's accounts are worthless—unless you count all the million-buckle lawsuits for fraudulent malfeasance that have been filed against the firm because of him." Tapping my watch pointedly, I now focused my vision clearly on J. Davis Alexander's disagreeable features. "According to this, I have an appointment at the Ritz-Carlton in twenty minutes with those characters from Earth who're backing the Ore-ball Express." I scowled as ferociously as I could. "So either fire me now or let me go to my meeting—and we'll say no more about me taking over Hooten's accounts."

The malignancy of J. Davis Alexander's answering scowl was enough to stop a 50,000 ton ore shipment dead in its trajectory. For the thousandth time I marveled that so hideous a troll could be the blissful husband of Miss Grain Harvest of 2273, a creature half a meter his superior in height and the tallest, slimmest, blondest, and flat-out most beautiful woman in the entire Belt. "The Ore-ball Express," he growled, "that's this goofy venture Old Man Choupette has got us in for 14 percent of?"

"That's the one," I said evenly.

"And you're the only one who knows what it's all about?"

I shrugged. "Except for Mr. Choupette, of course."

"Blackmail, White, sheer blackmail! I won't forget it. Now get to your meeting!"

The ore-ball floated in the diamond-filled blackness of space like a giant orange from which a titan had taken a single enormous bite.

"This," I said, gesturing at the hologram that filled one side of the conference room from floor to ceiling, "is what the Express looked like three days ago. It's not really orange—that's just the lighting we used to shoot these pictures for you."

Tamuela Tetuanui, Minister of Development of the Queendom of Tahiti, pointed a thick brown finger at the ore-ball. "How much longer before

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they've finished the ball? It's absolutely vital that it arrives on Earth in time for our Independence Day celebration."

I gestured at the project's lead engineer.

"Another week at the most," said VettiLou Propokov, a pale blonde girl with prominent cheekbones who looked hardly old enough to be out of high school and who was the Belt's leading engineer in the field of experimental virophage mining. "Using the usual rock-eating bacteria, two standard mining blocks of approximately 190,000 tons apiece have yielded about 55,000 tons of nickel-iron ore, just about the same weight as the standard 32-cubic-meter shipping blocks presently being sent to Earth. We've taken the refined ore and mixed and compressed it with the binding agents of our new technique to make our patented slurry. Then it's just a question of spraying it all into place."

She pointed at the orange ball and it immediately expanded to fill half the room. Now we could see half a dozen powersuits floating in space around the ball and its true size snapped into focus. "You can see the hoses they're using to spray the slurry against the mold. When we go into full-scale production the process will be mostly automated. Right now, with this demonstration model, we're using far more manpower than we will in the future."

"I can't see any mold," objected the only woman in the four-person delegation of Polynesians who had made the 538 million kilometer trip from Earth to check on the status of their project.

"It's only transparent from a distance," said VettiLou Propokov. "Where they're working, spraying the slurry, they can see a network of light yellow veins throughout the mold. When the ore-ball's complete, we'll dissolve the mold with a solvent."

"That mold, or wall, or whatever you call it, looks awfully thin to me," said the Minister of Development. "Are you *sure* it's thick enough for a trip to Earth and a splashdown?"

"Unless every computer in the Belt is malfunctioning," said VettiLou Propokov, "the Express is theoretically strong enough to support a constant 4.6 *g*'s and a splashdown at a speed two and a half times greater than the one actually programmed. To reduce costs, of course, our actual propulsion system will only be thrusting at .087 *g*'s for three and a half days, but that's still enough to get it to Earth in a little over twenty-four days. I give you my word, Mister Minister, the Ore-ball Express will function exactly as designed—and will deliver 55,000 tons of highly refined nickel-iron to Port Pomaré for 23 percent less than any competitor on the Moon or in the Belt."

"There's really 55,000 tons in that ball?" demanded another of the Tahitians. This one's face was covered by an intricate pattern of blue and black tattoos that made him look more like a ceremonial devil's mask than a human being.

"Absolutely. A cubic meter of refined ore weighs about 1,600 kilograms at one standard Earth gravity. The wall of the ore-ball will be exactly three meters thick, with an exterior

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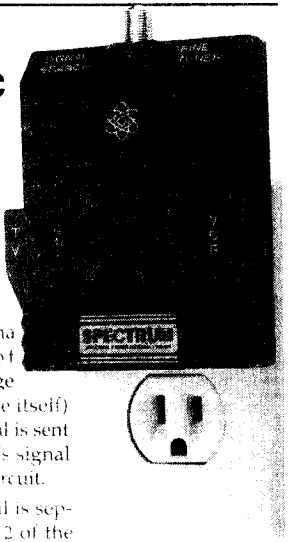

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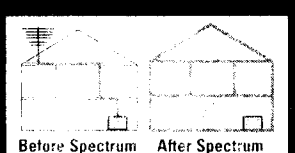

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surface area of 12,870 square meters and an interior volume of 92,000 cubic meters—according to our computer modeling the perfect proportion of cargo to flotation value to cost." VettiLou Propokov flicked her pale blue eyes from one Polynesian face to the next. "Believe me, it will work."

"For 78 million solid gold Belter buckles," I said dryly, finally breaking my long silence, "it had *better* work. Especially from Mr. Choupette's point of view. Fourteen percent of those 78 million are *his*."

"Except that your Monsieur Choupette didn't actually put a single buckle of his own into this project, either plastic or gold," groused the Minister of Development equally dryly. "The only thing Hartman, Bemis & Choupette has done for us was to handle the initial stock offering—and take 13.64 percent of the ownership in return. Her Majesty the Queen is still smarting about that."

It was clear that Polynesians still didn't grasp the concept of venture capital. Diplomatically, I shifted the subject. "The ore-ball's only 800,000 klicks away, about seven hours at a constant .5 *g*. If you'd like to visit it, we've made arrangements for a ship. We can leave anytime you'd like."

"As soon as we can," said the Tahitian with the tattooed devil's mask. "The industrial zone at Port Pomaré is still under construction. As soon as we're assured that the Express will be on schedule, we'll step up the pace to make certain it's finished in time for the Independence Day ceremonies."

"And exactly which day is that?" I asked. I always have trouble remembering the significant dates of the three or four thousand squabbling nation-states that make up Earth.

"Why, the 10th of August, the 281st anniversary of the day we achieved our independence from the French colonialists." Everyone in the delegation of Polynesians seemed surprised that I didn't know the date by heart.

It was my turn to be surprised as we drifted through the brightly lighted interior of the Ore-ball Express inside our borrowed powersuits. In the four days since the hologram we'd seen at the Ritz-Carlton had actually been filmed, the basic structure of the ore-ball had been completed and a simple airlock installed in its thick wall of highly compacted nickel-iron ore. A dozen figures in powersuits darted about the relatively tight confines of its interior in purposeful fashion. Some of them, it was obvious, were checking the inner wall of the multi-million-buckle ore-ball for structural defects. The others were occupied in less obvious ways.

"You didn't know about *that?*" marveled VettiLou Propokov, her big blue eyes batting at me innocently from behind the faceplate of her powersuit. "That's the acceleration couch we're installing for the Crown Prince."

"The acceleration couch? The Crown Prince?" Now that I knew what we were dealing with, I could see that the device mounted in the middle of a complex system of heavy-duty gimbals was indeed an acceleration couch, a very well padded one. The gimbals, in turn, were secured in

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the center of the ore-ball by an elaborate structure of tubing sprouting from all sides of the walls.

"That," said VettiLou Propokov complacently, "is the chair that Crown Prince Ata of Raiatea will be sitting in when the Ore-ball Express makes its historic descent from Earth orbit to splashdown at Port Pomaré. All those tanks, tubing, and hoses you see are the life support system—not that he'll need very much: it's only a seventy-seven-minute ride from orbit to splashdown."

"From orbit to *splashdown?*" I frankly goggled. "You mean a human being is going to *ride* this thing down at a million klicks an hour?"

"Much, *much* slower than that." I could see her shrug inside her powersuit. "It's to prove how safe the ore-ball is. That's why the Crown Prince himself will be the passenger. No one has ever done anything like this before—everyone in the Solar System will be watching. It'll generate *enormous* publicity. If the Crown Prince is willing to risk *his* skin, it's *got* to be safe."

"Safe." I slowly raised my jaw from where it had been hanging on my chest. "Has anyone asked the Crown Prince *his* opinion of this?"

"Not yet." VettiLou Propokov conceded. "But he'll go, all right. His mother the Queen will speak to him very firmly about the matter—she can be *very* persuasive."

I could believe that. I'd seen holograms of Her Royal Highness Queen Teraimateata Mara Pomaré, Protector of the Seas, Fisher of the Heavens, and Dancer upon the Waves. She was as big around as any three sumo wrestlers together, and her round brown face was fixed in a permanent scowl that make J. Davis Alexander's seem merry by comparison.

"Besides," the Belter engineer added, "we've got a bit of an inducement on board for the Prince courtesy of some shareholders on Pallas." She nodded in the direction of a half-dozen gleaming metal drums that were being attached to the far side of the curved wall. "His Highness is, let us say, a man who will take a drink from time to time. Even two or three of them, if you see what I mean."

"In other words—a drunk."

"Well, yes. Apparently he particularly likes fruit brandies. There's a French immigrant with a hydroponic orchard over on Hygeia who's been distilling the stuff for years now." She shuddered convulsively. "Horrible stuff: sweet and sticky, completely colorless, and all of it at least 180 proof." She gestured at the barrels. "It's also so harsh you could sell it as paint remover, or, if you ignited a barrel, you could use it as a propulsion unit and drive the whole damn ore-ball to Earth."

I wasn't completely convinced of *that,* but, as I lifted my own infinitely more civilized glass of Pernod and water to my lips at the Café des Mondes, my thoughts drifted back to the drums of high-priced rot-gut stored away inside the Ore-ball Express.

"It's tiny details like that," I pontificated, "that sometimes make the difference between a successful stock offering and a failure. I have to admit it,

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whoever thought of this stunt of using the Crown Prince is a genius. But personally I'd rather go over Angel Falls in a *gravy* boat."

Isabel, my long-time girlfriend, grinned at me over her tequila sunrise, then shook her glossy black bangs. "I thought you'd already *had* your stock offering, the one that made Hartman, Bemis & Choupette 13.64 percent part-owners of this holding company that owns the ore-ball."

"Orbex, Incorporated? Yes, but that was only the *initial* public offering," I corrected. A little more than a week had passed since our inspection of the Ore-ball Express and this was the first time I'd had to get together with both Isabel and her wife, Jin Tshei. We were sitting under the green and white striped awning of our favorite sidewalk café just across the street from the duck pond and within full view of the baleful scrutiny of J. Davis Alexander. Isabel has two degrees in resource allocation management, a high-powered job in the assessor's office in City Hall, and a fine head for precise figures, even out to two decimal places.

"Once this first shipment to Earth has shown how practical and profitable this method is," I went on, "we'll have a secondary offering to raise another 225 million buckles. That's what we'll use to get the ore-balls into full-scale production."

"What *I* don't understand," said Jin Tshei, sipping delicately from her *kir royale,* "is why you're spending millions and millions of buckles to reinvent the wheel—a *broken* wheel, at that." She turned the full wattage of her almond-shaped eyes upon me and I felt my knees quiver. Jin Tshei is the Assistant Curator at the Clarkeville Museum of Art and Human Achievement and, after Miss Grain Harvest of 2273, hands down the second loveliest creature in the Belt—or perhaps the entire Solar System. I occasionally had sharp pangs of jealousy that it was Isabel who was married to this exquisite woman and not me, but for the most part I maintained a reasonable stoicism about the limitations of our informal little triad. "I *know* we've got a model somewhere in the museum of the earlier ore-balls that used to be shipped to Earth. I think they were in regular use up to about 50 years ago."

"Absolutely right," I agreed. "And then one of them broke into a million pieces in the upper atmosphere over the Indian Ocean and gave Western Australia the most beautiful shooting star display in history. And 67 million buckles worth of nickel-iron either burned up or sank to the bottom of the Indian Ocean. The insurance companies suggested very strongly that we Belters find another method of shipping our ore. So we started sending it back in nothing but solid cubes."

"Then how come you're doing the balls again?"

"Fifty-three years have passed. An entirely new technique for temporarily bonding the nickel-iron molecules together has been developed by Polymer Metals over on Camilla, the company VettiLou Propokov works for. This new ore-ball we're putting to-

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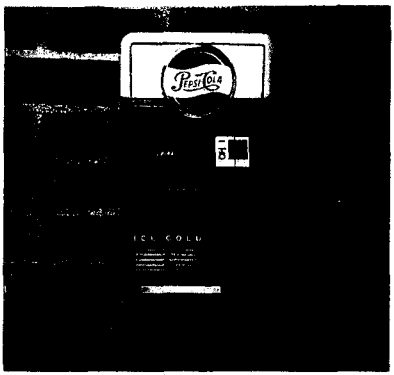

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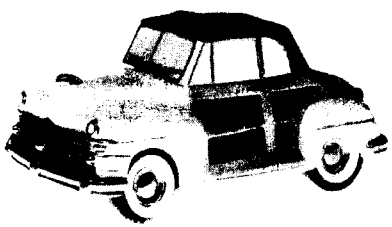

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gether will have at least seven times the rigidity and tensile strength of the old ones. It's like comparing a rope suspension bridge to the Golden Gate. *This* one could be accelerated at a constant 4.6 *g*'s all the way to Earth if need be. And Orbex has bought 100 percent of Polymer Metals, so no one else will be able to copy our technique—we'll have the market entirely to ourselves."

Isabel, who's about my age, around thirty-one or thirty-two, if it matters, and nearly as tall as I am but far rounder and smoother in those places of interest to practicing heterosexuals like myself, nibbled pensively at a tiny green cornichon. Through a series of events too tedious to chronicle here, she, Jin Tshei, and I are the proud parents of a gorgeous little six-year-old girl who, for the time being, is unfortunately constrained to live on Earth. So every now and then the three of us get together at the Café des Mondes and, among other things, discuss which of us will make the next trip to Earth to visit Valérie-France. Which was how we had gotten onto the topic of the Ore-ball Express.

"Four point six *g*'s?" repeated Isabel incredulously. "That'd get it to Earth in a couple of days! What's the hurry?"

"Well, in general, anything that saves you time will eventually save you money. Those solid cubic blocks of ore we've been shipping to Earth for 50 years now could probably withstand the same amount of *g*'s but it's just too expensive to rig them with such powerful propulsion systems. Where we'll kill them on the costs is on the other end, on Earth. Right now they have to put the block into high Earth orbit, attach all sorts of guidance and flotation devices, then send it down to a soft, *soft* landing. Then they have to haul 50,000 tons of dead weight through 3,000 klicks of Indian Ocean, still sitting in the middle of all its flotation junk, to the nearest factories in Perth or Flinders Bay. None of the countries sitting beside the ocean will let it come down any closer than that."

I popped my daily gravity pill into my mouth and washed it down with a long swallow of Pernod. "What the Queen of Tahiti wants to do, though, is to land the Express right smack in the middle of her backyard—and it's a *big* one. The Polynesians have got 115 islands scattered over 9 million square klicks of Pacific Ocean to use for splashdown. And instead of having to tow the damned thing a couple of thousand klicks, they're building their own metallurgy industry ten or fifteen klicks away from splashdown."

"So this whole project is just as important to the Polynesians as it is for you and this new company you and your crooked bosses have floated?"

"Orbex, Inc.? More so. Without the ore, they'll have built an entire industrial and manufacturing zone in the middle of the Pacific Ocean for nothing. I don't know if they still cook their queens and eat them in Tahiti when things go wrong, but—"

I was interrupted by the beep of my wristphone.

"That was one of my crooked bosses," I said, setting down my empty glass, "the round, hairy one with the sunny disposition. He wants me back

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in the office. At least I *think* he does—he was gobbling so badly I could hardly tell what language he was speaking."

J. Davis Alexander was still barely coherent when I entered his office on the other side of the park. Lurking behind the foliage of his furry face was something more than simple rage, though, some other emotion I couldn't immediately put my finger on.

"White," he croaked, having slammed shut the door and pulled tight the curtains that I had never before seen closed. "Give me your wristphone."

"Give you my . . . *wristphone?*"

"Now!" He glowered at the inoffensive instrument as he turned it over and over in his hairy hands as if it were a time bomb about to explode. "Just making sure no one could be listening in on us." He jammed the phone into his pocket, then gestured me closer . . . closer . . . closer—until one meaty arm was clamped around my neck and his fleshy lips were pressed nearly against my left ear. I recoiled from his hot breath—had he finally gone irrevocably crazy?

"White," he whispered fiercely, "if you ever breathe a *word* of what I'm going to say, I'll . . . I'll *kill* you! Do you understand?" His grotesquely powerful arm tightened around my neck.

"Umph," I grunted, "you *are* killing me!"

If anything, his grip only tightened. "It's my nephew Hooten—he wants to kill *me!* You've got to stop him, White!"

"*Hooten?* Kill you? Then he'll just have to get in line with all the rest of us." I pushed with all my strength and managed to wriggle a few centimeters away from his embrace. "You mean your nephew wants to kill you just because you fired him? You've fired *me* dozens of times—and you're still alive."

"This is *serious,* White. You've *got* to save me."

"From Hooten? I'm an ethical broker & bourseman, remember? *Not* a bodyguard."

"It doesn't matter, you're the only one I can trust."

"Then why don't you stop trying to strangle me and tell me what it's all about?"

Eventually, in disjointed bits and pieces intermingled with threats and self-pitying whines, I got the gist of J. Davis Alexander's sad tale.

Years before, at the successful culmination of one of his more remunerative deals of dubious legality, the managing director of Hartman, Bemis & Choupette had opened a numbered bank account in Liechtenstein, a tiny nation-state in Europe that exists primarily to service clients with the ethics of J. Davis Alexander. As time went by, his bank account grew larger and his paranoia more pronounced. He converted the numbered account into cash, gold ingots, and bearer bonds. These he stored in a box 2,000 meters beneath the Alps in the same Liechtensteinian bank, secure now against even nuclear fusion.

"And now," groaned J. Davis Alexander in piteous tones, "that unspeakable Hooten, my own flesh and

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blood, is on his way to Earth to steal everything I own. He'll kill me, White, *kill* me!"

I extracted the rest of my neck from his python-like grip and eyed him coldly. "You mean all of this hoohaw is because you think Hooten is going to steal your money? From a Swiss bank box two klicks beneath the Alps? You don't need a bodyguard, you need a custodian!"

"Liechtensteinian, not Swiss." J. Davis Alexander's angry glare was only a pitiful travesty of its former nova-like wattage. "You don't *understand,* White, it's not just a regular bank box where you have to prove your identity to get access to it, it's a *bearer* box!"

"A bearer box?"

"Like a bearer bond—anyone who bears the codecard to it is assumed to be the rightful owner. With absolutely no questions asked."

"Oh. And Hooten has the codecard?"

"He stole it, White, right out of my office safe! Oh, the perfidy of the man!"

"How can you be so sure it's Hooten who has it? Who else—"

"The safe is only keyed to two thumbprints, you idiot, mine and Hooten's! I was so . . . distracted when I fired him that I forgot to cancel his authorization. Any time the safe is opened, a video is made of whoever's using it. It was Hooten, all right, two days after I fired him, that bloodsucking murderer Hooten!"

I fingered my chin. "So now he's on his way to Earth with your codecard. And all he has to do is waltz into the bank, stick the card into a slot or two, and walk off with all of your money." I considered my boss carefully—it was hard to believe that so basically dishonest and conniving a schemer could ever have been so stupid.

"It's worse than that, White," he murmured in mortified tones. "There are . . . other . . . things in the box. Things that if Melinda ever saw, she'd . . . she'd . . . it'd be the end of our marriage, White, the absolute end! If she didn't shoot me first." He turned away, his shoulders quivering.

I regarded him with amazement. Melinda, of course, was Miss Grain Harvest of 2273, the Belt's most gorgeous woman and J. Davis Alexander's improbable trophy wife. Was it possible that inside the old wolverine a few reputable human emotions still existed—such as shame, remorse, *love?* I shook my head in wonder: J. Davis Alexander a human being? Such a fanciful notion had never before crossed my mind.

And now I finally realized what other emotion his furry face was concealing besides simple rage: out and out fear.

"So what is it you want me to do?" I asked finally.

"Do? Go to *Earth,* of course, and get to the bank box before *he* does, you numbskull! What else do you think there is to do?" I was relieved to see a little bit of his basic nature reasserting itself.

"So there's another codecard, is there? One I could use to open the box?"

"Yes, I kept a second one hidden at home—just in case."

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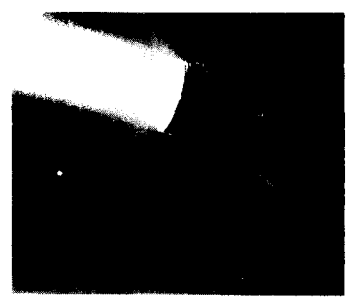

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"Very wise." I pondered J. Davis Alexander's words. Our daughter, Valérie-France, was on Earth, in a special school/home/medical center for the very occasional Belter child who is afflicted with Kesler's Syndrome in spite of the gravity pills that all children begin taking as soon as they leave the Earth-normal gravity of Maternity Rock. Unless Vally wanted to end up looking like J. Davis Alexander, she would have to stay on Earth until her growth stabilized at eighteen or nineteen standard years. It had been eleven months now since I had last seen her. "You want me to go to Liechtenstein?"

"Yes."

Liechtenstein was next to Switzerland, and Valérie-France's clinic was in Switzerland.

"Why don't you go yourself? Now there's one *more* person who knows about the bearer box."

"You expect me to be able to take two months off from my duties, White? Are you *crazy?* With that billion-buckle Medimax issue coming up? Of *course* you're going!"

"First-class round trip, all expenses paid? Full salary while I'm gone, at double overtime?"

"Yes, yes, *yes!* Just go, White, *go!*"

"I'll do it," I said. "Let me go find out about packets."

"I've already done it," said J. Davis Alexander, settling back in his seat and fixing me with his customary beady eye. "Hooten took the *Yankee Flyer,* which left Ceres eleven days ago. Luckily for us, it's going via Vesta, so he won't be getting into Earth orbit until around three in the morning GMT on August 12th. If he hurries, he could be at the bank the same afternoon. So, just to be on the safe side, you've *got* to get to Earth by at least the 10th."

"Yippee," I muttered, my mind already turning to the presents Isabel, Jin Tshei, and I would be getting for Valérie-France, "that means I'll be there in time to celebrate Tahitian Independence Day. So what packet have you got me booked on?"

"It's not exactly a packet," snapped J. Davis Alexander. "There *are* no ships from anywhere in the Belt that could get you to Earth by then." He leaned forward, his malevolent little eyes boring into mine. "You, White, are about to go down in the annals of history: you are going to be the first human being to travel from the Belt to Earth inside an ore-ball express!"

This, I reflected sourly as I scowled at the cramped quarters of the tiny beltship that were going to constitute my living space for the next twenty-three days, was a scheme you could pull off only if you owned 13.64 percent of the stock in Orbex, Inc. You could delay the departure date of the Ore-ball Express by thirty-six hours and have its feeble little propulsion system reprogrammed to thrust at .1 *g* instead of the .087 already scheduled—just enough, according to VettiLou Propokov, to get me into Earth orbit by August 10th, just in time for the Polynesians' Independence Day celebrations, and nearly two full days before the *Yankee Flyer* bearing Hooten Delahooty and his favorite uncle's codecard were due to arrive on

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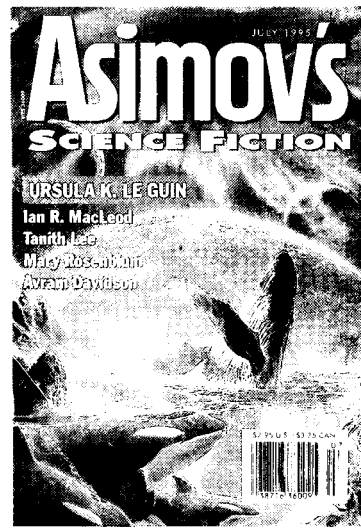

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their way to the Banque Unione de Vaduz.

It was, I supposed, remarkable—and reflected the extent of J. Davis Alexander's desperation—what the resources of Hartman, Bemis & Choupette had managed to get done in a mere thirty-six hours.

A one-man beltship small enough for its essential components to be passed through the airlock in the side of the Ore-ball Express had been located and chopped to pieces. Nothing remained of it now except for its living quarters and life-support system. My new home was hardly larger than a good-sized powersuit but infinitely more comfortable. Besides having a narrow bunk that folded down from the port wall, it boasted a tiny bathroom and an even smaller galley.

"Everything looks all right?" asked VettiLou Propokov, floating upside down in her powersuit in the ship's airlock. I nodded glumly. "I personally checked the water supply, power, lighting, the galley, the head, and the air-recycling," she assured me. "Everything is fine—you should have a very comfortable trip."

"I've got thirty classic books I've always told myself I was going to read someday and an instructional chess program—the trip may be boring, but at least it's going to be educational."

It was also, I discovered, three and a half days later, going to be cold.

They'd forgotten to install the beltship's heating system.

In another two days, when the power inside my self-contained powersuit ran out, I was going to freeze to death.

They'd also forgotten the communication system—or, more likely, simply overlooked the fact that it wouldn't function from inside a sixty-four-meter ball of nickel-iron ore with three-meter-thick walls.

By the time I discovered *that*, the Ore-ball Express was 36 million klicks from Ceres and still accelerating at a constant .1 *g*. We were, my pocket calculator informed me, now moving at 286 klicks per second and picking up speed with every passing moment. Already it was far too late for anyone in the Belt to match courses with me—even if I *had* been able to get anyone to hear my frantic screams for help.

But why, you ask, had it taken me three and a half days to discover that I was going to freeze to death?

The answer, it seems, is in the intrinsic insulating properties of nickel-iron ore walls three meters thick—and the almost equally fantastic insulating values of a beltship's far thinner metal and ceramic skin. Together they had served to retain the substantial heat buildup that a week or so of various engineering tasks had generated within the hermetically sealed ore-ball. Then, once we were underway, these same walls had kept the near-absolute cold of interplanetary space from seeping through.

For a while. . . .

When first my numbed fingers and then the beltship's thermometer told me that I was getting *cold* I merely growled irritably. Carefully dog-earring page 379 of *Moby Dick*—it was

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fully as tedious as I'd expected it to be—I moved carefully from my bunk through the unaccustomed 10 percent gravity to the thickly upholstered easy chair that had been brought in to replace the pilot's command chair.

I scanned the control panel, idly fingering the outlines of J. Davis Alexander's all-important codecard that for safety's sake had been taped to the bare skin in the center of my chest. Where, I muttered, were the life-support controls?

Ah, here.

One dial was clearly marked CABIN TEMPERATURE. I turned it from the present arctic-like 8 degrees Celsius to a toasty 28, tightened the bunk's blanket around my shoulders, and sat back to wait.

Nothing happened.

Twenty minutes later I had located the nine widely scattered vents through which warm air was supposed to be pouring into the cabin. I held my hand in front of each small opening.

The only air coming through was cold enough to form icicles on my fingernails.

I didn't panic—yet.

It took another five minutes to get what remained of the beltship's computer system to bring up the repair manual on screen. I jumped it to Heating, Cabin, Internal.

Then to Source, Schematics.

I wanted to scream.

Heating for the beltship's living quarters was generated and stored as a by-product of *its* propulsion system.

The propulsion system had been cut out and discarded 36 million klicks away so that the rest of the beltship could be installed in the ore-ball.

The only cooking heat in the galley was provided by microwaves.

There was no way to heat the cabin. And no way, I now discovered, to call for help. Unless I did something clever in the next few hours I was going to freeze to death.

I folded the blanket in two, pulled it around my shoulders, and tried to think.

After a while my glazed eye and numbed brain came to the yellow and blue powersuit that I had worn when I'd made the final transit through the airless ore-ball into the beltship cabin. Now it hung forlornly in a niche next to the galley.

The powersuit—it had its *own* internal heating system!

I leapt to my feet, my heart thudding violently.

I was saved!

Every Belter, even the most chair-bound ethical broker & bourseman, knows how to use a powersuit. Ninety seconds later I was inside the suit and had snapped the faceplate shut. A warm glow suffused mind and body as the subtle heat of the life-support system automatically swung into action. I sank back into my easy chair and wriggled my half-frozen toes luxuriously. It was going to be a long, boring nineteen and a half days inside the powersuit but at least I would make it to Earth as a hunk of animated warm meat instead of a frozen corpsicle.

And I could always play chess on the faceplate's holographic display visor.

Which reminded me. . . .

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I pressed the wrist controls that were just one of the powersuit's four independent ways of activating the display, then brought up the suit's operating system info. My eye ran over the red characters arrayed in neat lines.

Everything was normal.

Interior suit heat was already 11 degrees Celsius at waist level and rising rapidly to the default setting of 22.

Oxygen content was—

My eye halted, went back to a previous line.

Power reserves: 48 hours, 23 minutes, .02 seconds.

Even as I stared at it the minute display changed to 22.

For a long breathless moment I once again felt the stirring of incipient panic. Then sweet reason reasserted itself.

All I had to do was recharge the suit by plugging it into the ship's power system. If there was enough power in what remained of the beltship for lights and air recycling, there *had* to be enough to run one miserable powersuit.

That was when I discovered that the suit's recharging cord with its universal adapter plug was missing. All that remained of it in the zippered pocket on the suit's left leg was a ten-centimeter section of heavily insulated wire with a badly frayed end. Even on Ceres, I reflected incredulously, there were rats hungry enough and stupid enough to chew through six-gauge cable. . . .

My eyes swung back to the power display—48 hours, 19 minutes, 24 seconds.

I ground my teeth angrily. I *refused* to be turned into a corpsicle on account of J. Davis Alexander and his wretched bearer box!

We Belters are a resourceful lot.

I shrugged myself out of the powersuit, then located the nearest of the cabin's standard power outlets. The galley provided a knife sharp enough to strip away the insulation from the recharging cable's two wires. A few minutes later I had three centimeters of neatly exposed copper wires on the end of the cable that projected from the powersuit.

I ran a quick mental review of what I had done, gave myself a mental pat on the back, and jammed the naked wires into the two slots of the outlet.

Flash!

Hiss! Crackle! Bang!

Sizzled fingers!

The acrid smell of power overload!

A wisp of pale blue smoke drifted out of the recharge pocket.

I gaped in dismay at the powersuit I had reflexively jerked away from the outlet and across the cabin. The two wires I had exposed were now a fused mass of melted copper. With leaden fingers I pulled myself back into the powersuit. I snapped the faceplate shut. The faint susurrus of its life-support system hummed softly in my ears. Warm air caressed my skin. At least the suit was still working.

I activated the faceplate display—and stared at it in horror.

"Power system storage failure," I read. "See a qualified technician immediately for replacement of storage unit. Unauthorized attempts to repair the system may further damage the SafetySuit's operation and void its war-

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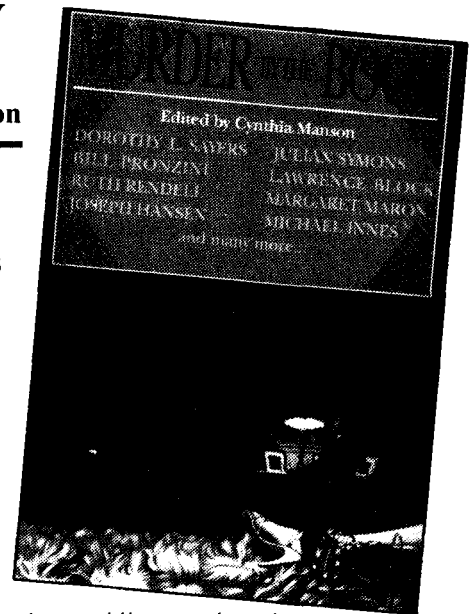
Edited by Cynthia Manson



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ranty. Power remaining for normal operation: 4 hours, 17 minutes, 51 seconds."

Not only had I irreparably destroyed the suit's recharging system, I had also discharged most of its stored-up power.

My torpid brain kept my eyes focused on the ever-diminishing seconds of my remaining life without really registering them.

That was when I began to panic.

I might well have arrived in Earth orbit literally frozen into a fetal crouch if yet another factor over which I had absolutely no control hadn't come into play.

It took me a long, *long* while to become aware of it. Finally, however, I noticed that my powersuit and I were no longer huddled in the beltship's easy chair; now we were floating a good 20 centimeters above it.

Sluggishly my brain began to function again.

I was no longer constrained by the puny .1 gravity of the accelerating oreball. Some time in the 15 minutes and 43 seconds since I'd last been really aware of the remaining time in the powersuit, the Express's propulsion system had shut itself off. According to VettiLou Propokov's programming, we were now drifting towards Earth at a constant 305 klicks per second—without gravity.

I floated aimlessly around the cabin, my mind racing furiously. No gravity, no gravity, no gravity—how did *that* help me in my present predicament?

I couldn't see that it did.

Did it, in fact, make things *worse?*

My focus came back to the inexorable passage of time in my faceplate display: 3 hours, 43 minutes, 07 seconds remaining in my powersuit.

The absence of gravity was *definitely* making things worse: just thinking about it, I had already wasted sixteen minutes of my few hours of remaining life.

For want of anything better to do, I let my gloved hands clumsily explore the various pockets and pouches attached to the powersuit. All of them were empty—except one.

Here I found two meters of neatly coiled recharge cable that some tidy soul had conscientiously tucked away for future repairs. On the end unchewed by my hypothetical Cerean rat was the universal adapter plug. One side of the plug had several lines of fine print on it. Squinting, I read:

"Your SafetySuit has been designed to work on its custom-made, built-in, 28-volt alternating current storage unit. Any attempt to recharge it from a standard 28-volt, direct-current prime power outlet without the use of this adapter will result in severe damage to the SafetySuit and will void any warranty or guarantees regarding its power unit."

So I'd plugged an AC suit into a DC outlet. To laugh or to cry, that was the question.

Instead, I uttered a sharp scream of rage and threw the plug so viciously into the galley that I was launched backwards across the cabin. Tumbling and waving my arms, I ended up with my head rapping the porthole beside the airlock. Through the porthole I

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stared vacantly into the darkness of the ore-ball's interior. Somewhere on the far side of the blackness I could catch a few faint glints of light reflected from the beltship's cabin. The barrels of booze they'd stored aboard for the alcoholic Crown Prince Ata, I told myself idly, and tugged my mind back to—

Barrels of *booze?*

Of *180* proof booze?

Two seconds later I had pulled myself down to the airlock and was fumbling frantically with its controls.

If only the barrels were small enough to go through the airlock. . . .

They were—with one centimeter to spare.

If there'd still been any gravity, of course, I wouldn't have been able to do it. Even without it, the 250-liter double-walled, stainless steel barrels still retained all of their mass and inertia. It was all I could do to pry them away from their fittings and then slowly shepherd them over to the beltship. By the time I'd manhandled the seventh and final barrel through the airlock and into the almost negligible remaining cabin space there were only twenty-seven minutes of power remaining in the suit—its life-support system had been working double-overtime to keep me warm in the icy chill of the ore-ball.

Now two of the barrels lay on my bunk, one sat upright in the easy chair with another perched on top, and the three others filled what remained of the deck space. There was just enough room on top of those three to lay the mattress I'd previously taken from the bunk. When the ore-ball flipped over and began its deceleration three days and fourteen hours out of Earth, and gravity returned to the cabin, I'd need somewhere to sleep.

Assuming, of course, I was still alive. . . .

Once again free of the confines of my powersuit, I inspected the seven barrels of high-class rot-gut. The Crown Prince either had a very catholic taste in alcohol or his well-wishers on Pallas were taking no chances in trying to capture his fancy. Each barrel of "Genuine Hygeian Eau de Vie, Guaranteed 180 Proof" was a different flavor: plum, passion fruit, apricot, pineapple, cherry, mango, and pear.

Eau de Vie, according to my limited knowledge of French, seemed to mean Water of Life. I supposed that if you were alcoholic enough, it probably was. In my own particular case, I fervently hoped it would live up to its name.

I cast a thoughtful eye upon the two barrels lying lengthwise on the bunk. I would start with them because their bungholes were already pointed towards the ceiling, but I'd start *carefully*. I'd already nearly irredeemably doomed myself with my feckless recharging of the powersuit. Another mistake of that seriousness, I knew, would absolutely kill me.

I tugged at my chin. I needed three things: a wrench to unscrew the stainless steel plug from the bunghole; a wick; and a starter.

The wrench was easy. Along with half a dozen other basic tools I found

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one in the galley's closet.

The wick was almost as easy. A spare shirt labeled 100 percent cotton that I'd tucked away in a drawer behind the bunk was torn into strips.

The starter was harder. In fact, half an hour later, I was still thinking about it, with an ever-mounting degree of panic lurking a hair's breadth away.

There was nothing at all in the beltship to start a fire, no matches, no electric sparker, no cook top, no soldering iron.

Not even two sticks to rub together.

The people who design and furnish beltships don't *want* you to have fires on board.

Think, White, *think!*

While I was thinking, I unscrewed the plugs from the two barrels of hootch that occupied my bunk. Purely out of intellectual curiosity I stuck a finger into the liquid in the closer of the two. It felt cool but not icy, and certainly not frozen; the drums, I realized, were actually enormous thermos bottles with half a dozen centimeters of vacuum between their double steel walls. Cautiously I licked my finger. VettiLou Propokov was right: the Water of Life was both sweet and sticky and yet harsh enough to peel the skin from the back of your throat. The pineapple was *really* bad; the cherry, on the other hand, perhaps wasn't *all* that awful. Thoughtfully, I stuck my finger in again, licked it clean. A warm glow ran through my body. It had been a long time since my last Pernod and water at the Café des Mondes. And I was awfully, *awfully* cold. . . .

The Devil was shaking me violently by the shoulder. "It's time to go to hell, White!" he was shouting at me, "time to go to hell!" All around his evil red face, orange and yellow flames flickered and twisted. I moaned feebly. Already the heat was overwhelming—and I wasn't even *in* hell yet. Even when I was dead, life wasn't fair. . . .

The voice continued to pound at me.

Eventually I forced a single eye open and saw, inside a powersuit, a blurry face bent over me. It wasn't red, and didn't seem to have horns. But I was *still* hot.

Awfully hot.

"Hot," I muttered as I felt hands tugging gently at all parts of my body. Once again I seemed to be floating, as if there were no gravity. Wherever I was, it definitely wasn't Earth. "Hot, hot, *hot!*"

"Too bloody right, mate," came the answering voice. "My suit here says it's 51 bleeding degrees centigrade in this hellhole. It's a bloody miracle you're still alive!"

"Drink," I whispered, clutching an arm. "Gimme a drink."

I felt a bulb being placed against my lips. Water squirted into my mouth and throat. I began to choke. "Not *that!*" I croaked. "Gimme a *drink!*"

"From what it looks like, mate, you've drunk it all—or burned it all up."

"Heating system," I explained as my eye closed under the million-ton weight of its eyelid, "jus' my li'l' ol'

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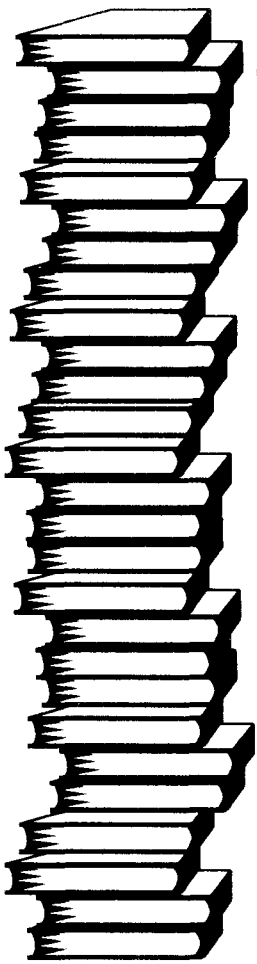

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heating system. . . ."

When my eyes opened again I was floating in another room altogether, surrounded now by *brown* faces. Polynesian faces. But since I was still weightless, it was obvious that I *still* wasn't on Earth. So what were all these Tahitians doing here? And why were they scowling at me so ferociously?

"You drank all of Prince Ata's *present?*" demanded a voice incredulously.

"Didn' drink it *all,*" I retorted indignantly, "jush made itsy-bitsy li'l' fire to keep ol' Jonathan warm, warm, warm. . . ." I could feel the side of my head bumping against my shoulder. My eyes closed again.

"Wake up, White!" A hand shook my shoulder. "You've got to do something for us."

"No, gotta do sump'in' for J. Davish Alexander." I blinked. "Don' know what, but gotta do it." I extended an arm imperiously. "Gimme drink, *real* drink."

A bulb was placed in my hand. I drank greedily. This was a *real* drink, just like the stuff in the barrels.

The roundest of the brown faces leaned closer. "All you have to do, Monsieur White, is just stay in the ore-ball a *little* while longer." Shiny white teeth flashed blindingly. "Not in that horrible cabin, though; in that nice big chair we've arranged especially for you."

"Nice big chair?" Vague memories drifted elusively through my mind. "Nice big chair for Crown Prince—*not* for li'l' Jonathan."

"Yes, but *now* it's for Jonathan." Another bulb was thrust against my mouth. Automatically I took a swallow. "It's just for a little while. And then we'll give you lots and *lots* to drink."

I nodded so vigorously that my chin fell against my chest and remained there. "Sure, sure, jus' give Jonathan a li'l' drinkie first."

"Of course. But first—" a screenpad and stylus materialized in front of my eyes "—just sign this little release, and *then* we'll give you a nice drinkie. . . ."

I slept, I suppose, all the way down to Earth—it really *was* a nice chair.

Then I slept for another thirty-two hours.

When I awoke, another set of brown faces was looking down at me. Gravity—*heavy* gravity—pinned me to my bed.

"Felicitations, Monsieur White," said one of the Polynesian faces. "You are the first man in history to ride an ore-ball down from orbit."

"I am?" My eyes widened. "But . . . but . . . there was a Crown Prince. *He* was supposed to ride it down. You mean that *I*. . . ?"

"The Crown Prince was unfortunately indisposed. You, Monsieur White, very gallantly volunteered to take his place."

I jerked erect in horror. "I did?"

"For a very substantial bonus, of course. And for the eternal gratitude of her Majesty the Queen. The pictures of you coming out of the ore-ball and falling to your knees to kiss the Queen's feet were most touching. Not to mention eliciting the gratitude of

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the stockholders of Orbex, Incorporated as well as that of your charming associates, especially Monsieur Alexandre."

Monsieur Alexandre: J. Davis Alexander! My heart lurched like a struggling animal imprisoned within my chest and my hands flew automatically to where the long-forgotten codecard had been taped to my bare skin. Against all probability, it was still there!

And now I remembered what I was on Earth for.

"Quick!" I yelped, somehow managing to swing my legs over the edge of the bed. "What day is it?"

"Day?" Six Tahitian faces looked at me in profound puzzlement. "Why it's the evening after Independence Day, August 11th."

Six hours later, thanks to a miraculous connection with the once-a-week Papeete-Paris fractional orbiter that left Tahiti at midnight, I set down halfway around the world in the spaceport carved out of the beet fields northeast of Paris. Here the ninety-minute flight had taken me into early afternoon. Twenty minutes after landing I was in a chartered aircab on my way to Liechtenstein and J. Davis Alexander's bearer box at the Banque Unione de Vaduz.

I was far too nervous to even look at the stupendous beauty of the Alps as they drifted past far below.

Not to mention having the father and mother and grandparents of all hangovers. Kettle drums played the William Tell Overture over and over in my throbbing skull and it was all I could do to keep from bleeding to death through my eyeballs.

An eternity later, now deep in the purple shadows of the majestic mountains, the aircab settled slowly into the bank's tiny parking lot. I focused blearily on my watch: it seemed to say twenty minutes before closing time. On wobbling legs I staggered into the cool, dark, wood-paneled lobby. Hooten's ship from Ceres, I knew only too well, had gone into orbit sixteen hours before. More than enough time to get the shuttle down to Earth and then to Liechtenstein. . . .

And if Hooten had gotten to the bearer box before I did, I might as well stay on Earth: my future with Hartman, Bemis & Choupette would be very, very circumscribed indeed.

The codecard worked precisely as J. Davis Alexander had promised it would. No human being challenged me as I pushed the card into one slot after another, gradually making my way through one security measure and then another, through the lobby, along a corridor, then down to the vaults far beneath the surface. Finally I watched a set of massive steel bars swing slowly aside and I stepped into a narrow vault filled with gleaming stainless steel deposit boxes. There before me was what I had come 538 million klicks for: J. Davis Alexander's bearer box.

With fingers that visibly trembled I pushed the card into the slot on the box's glistening face.

Whirring softly, its door began to open.

Hardly daring to breathe, I pulled the exposed box towards me. Sup-

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pose Hooten had gotten here ahead of me. . . .

I opened my eyes.

The box was jammed with currency, coins, glittering gold ingots, sealed manila envelopes, and colorfully printed bearer bonds.

Without examining it any further, I began to shovel everything in sight into the Air Polynésie flight bag I had picked up somewhere en route. Moments later the box was empty and the bag zippered tight.

Even the smallest gold bars are far heavier than you'd ever think possible. I was concentrating on using both hands to lug the flight bag through the door of the vault when I unexpectedly bumped into somebody rushing into the vault.

"White! What are *you* doing here?"

"Hello, Hooten." When I'd stilled the beating of my heart, I managed a polite nod for J. Davis Alexander's least favorite nephew and tried to sidle past his lanky frame.

His long, equine face thrust into mine. "I said, What are you *doing* here?"

"Just checking my bank box." With a determined bit of shoulder work I made it past Hooten and into the small paneled foyer at the base of the elevator. I thumbed the button.

Behind me I heard a muffled cry of rage. "It's empty! It's—"

The elevator door opened and I stepped inside. Two hands fastened around my neck and yanked me back out. The hands tightened. "You've stolen it, White, you've—"

The fingers fell away from my neck and I whirled around, the flight bag clutched protectively to my chest.

Hooten was in the grip of two bulky gentlemen wearing discreet blue suits. "Please, *Mein Herr,*" one of them murmured to the furiously thrashing Hooten as he tightened his forearm around the Belter's scrawny neck, "this gentleman is under the protection of the Banque Unione de Vaduz." He turned to me. "Would you care to give him in charge, sir?"

I stepped back into the elevator and cast a final glance at Hooten. "No, just keep him calm until I'm in an aircar."

The elevator door shut on Hooten's indignant shrieks.

"So now you're rich beyond the wildest dreams of avarice," marveled Isabel with an ironic twist to her lips, "and you can use whatever evidence you found in the box to pry Miss Rutabaga of 2270 away from J. Davis Alexander and into your own little harem." She exchanged complacent smiles with Jin Tshei, who reached across the table to pat her hand fondly.

"I admit the thought flashed briefly across my mind," I grinned, raising my eyes from our table at the Café des Mondes to the corner office of Hartman, Bemis & Choupette where even now J. Davis Alexander was undoubtedly casting about for reasons to fire me.

"The dreams of avarice, that is," I added hastily, "not Miss Grain Harvest of 2273. But on mature consideration I decided it would be far less stressful just to step into the Farmers Bank of Liechtenstein on the other side of the

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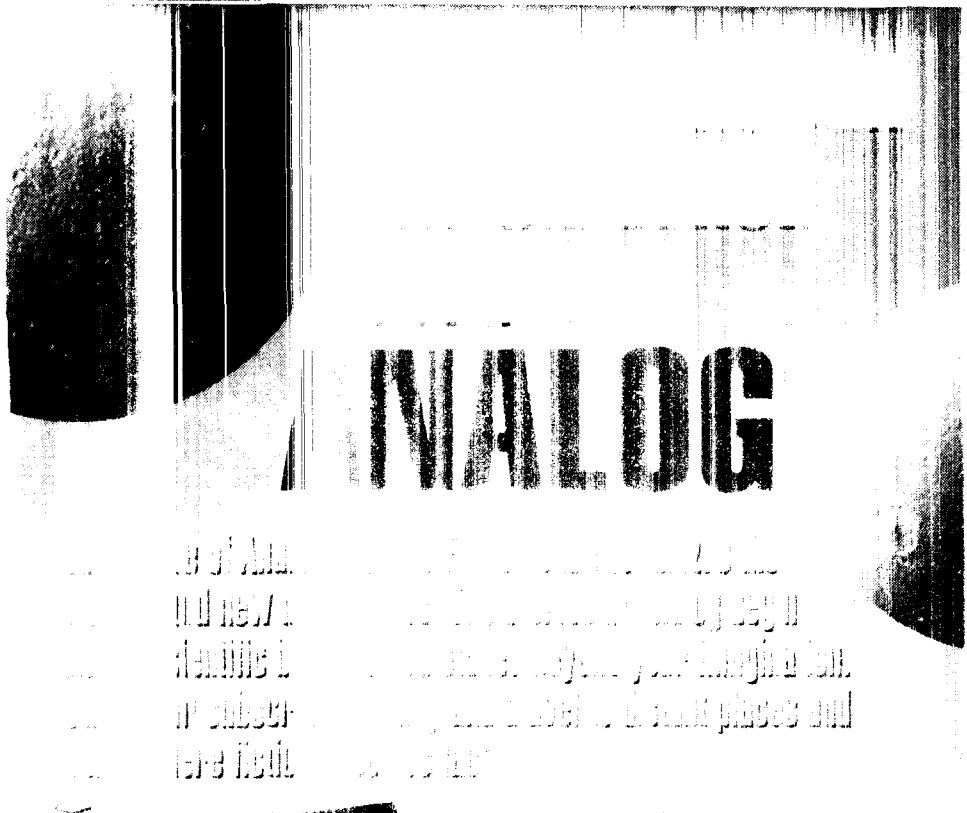

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street and dump everything into a new bearer box over there. Let J. Davis Alexander worry about having Miss Grain Harvest find the new code-cards."

Both ladies patted my hand simultaneously. "Very wise," approved Jin Tshei, enveloping me in the radiance of the multi-gigawatt smile that always turned my legs to jelly. "But you *still* haven't told us how you managed to keep from freezing to death."

I shrugged casually, as if I made Houdini-like escapes every day of the week. "Very easy, when you think of it. I stuck one piece of torn-up shirt into one of the barrels, the pineapple brandy, I think, as a very small wick, tightly stoppered, and kept that going as my pilot light. Then, with a little experimentation, I got a much bigger piece burning in the other barrel. That's the one that was doing the actual heating."

"But the smoke," objected Isabel. "It must—"

"Beltships have very efficient recycling and scrubbing equipment, even if their heating systems leave something to be desired. All I had to do was make sure I didn't run out of clothes to burn—and to remember to change barrels whenever one of them was used up."

"Yes, *that* must have been the hard part," said Jin Tshei tartly, "especially since you seem to have been as busy drinking the stuff as you were burning it. Falling down on the feet of the Queen! Really, Jonathan White, you ought to be ashamed of yourself! Ten billion people watched you make a fool of yourself!"

"The Queen thought it was a very nice gesture," I muttered defensively. "Showed the proper deference to her lofty stature and all that. No one told her I had simply passed out." I took a sip of the Coca-Cola that had been my only drink at the Café des Mondes since returning from Earth and grimaced. "Her son the Crown Prince was drying out at a clinic in New Zealand with the D.T.'s, you know. That's why *he* couldn't make the trip down to Port Pomaré."

"But how did you get the damned wick burning in the first place?" demanded Isabel impatiently. "I thought you said you didn't have any matches or any way to make a fire."

"Yes, that *was* a little bit of a problem. But after a while I stopped licking the Water of Life off my fingers and remembered that I'd just nearly charred them to the bone by fiddling around with the powersuit's wiring. So I ripped a couple of meters of wire out of the suit, jammed one end into the ship's outlet, and crossed the other together over the pilot light in the barrel. Bingo! A nice bright spark—and a nicely burning wick."

Isabel gave me a hard stare. "Would you ever have done anything so absolutely stupid if you hadn't been drunk?"

A long silence. "We'll never know, will we?" I shrugged at last. "Anyway, it wasn't *entirely* my fault. I said that the air-scrubbers were super-efficient at cleaning the air and removing smoke. Very true—but it's also true they weren't designed to cope with the fumes of several thousand liters of burning mango brandy, either. At the

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same time they were filtering out the smoke, they were pumping pure alcohol vapor back into the cabin. *That's* what kept me drunk for nineteen and a half days."

Jin Fshei grip's tightened on my hand. "Brave, intrepid Jonathan Welbrook White, pioneer drunken space hero!"

"I'll never live it down," I admitted. "On the other hand," I added, my tone brightening, "the demonstration of the Ore-ball Express did just exactly what we wanted it to. The secondary offering for 220 million was oversubscribed. Orbex Inc. is getting ready to go into full-scale production of ore-balls, and the stock the three of us own from the initial offering has already quadrupled. And just between us, I just *may* have made a copy or two of some of the . . . spicier material in those sealed envelopes I found in J. Davis Alexander's bearer box. Who knows: it might be useful to mention that fact the next time our furry friend up there takes a notion to fire me."

I gestured imperiously to the lifelike robot attendant in his old-fashioned black suit and white apron. "*Garçon!* Another round of drinks for the ladies—and a Coca-Cola for the gentleman!" ■

MANY THANKS TO GERALD NORDLEY FOR INITIALLY SUGGESTING THE IDEA OF THE FLOATABLE ORE-BALL AND THEN DOING CALCULATIONS ON ITS FEASIBILITY. ANY MISTAKES IN THE STORY, HOWEVER, ARE ENTIRELY THE AUTHOR'S.

Editor's Note: Earlier stories of Jonathan Welbrook White, Ethical Broker & Bourseman, include "Six Million Solid Gold Belter Buckles" (August 1994), and "Deep-Fried Black Diamonds" (January 1995).

Forgive me my nonsense, as I also forgive the nonsense of those who think they talk sense.

—Robert Frost

The first principle is that you must not fool yourself—and you are the easiest to fool.

—Richard Feynman

The right to be heard does not include the right to be taken seriously.

—Hubert Humphrey

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G. Harry Stine

BEEN THERE, DONE THAT, BUT SHOULD WE DO IT AGAIN?

We can learn important lessons from the history of big technologies, but the lessons aren't necessarily simple!

Historical precursors and analogs are often invoked in an attempt to forecast or justify commercial space endeavors. This is especially true when space advocates attempt to make the case of getting government out of space and letting private enterprise take over.

History reveals that government participation in a technologically-based activity has both its benefits and its disadvantages. Therefore, we need to be cautious when invoking historical examples as justifications.

Caution is required because the record shows that, once a system is put into use, it's rarely changed and then only with great difficulty and often negative consequences.

The saying, "Been there; done that," applies. We've tried a lot of different approaches to the regulation and control of technology by both government and industry. Before we go charging off into the new commercial space age, we should reflect on what's happened in other industries and try not to reinvent the square wheel. It also behooves science fiction writers and readers to be aware of such happenings because this literary genre concerns itself—or should—with the impact of science and technology on people.

The Railroads

In the United States, governments at various levels have been involved

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with the railroads since their very inception.

During the 1830-1850 period, state and local governments invested heavily in the early railway companies. They were motivated by the desire to improve land values, attract people, and provide access to markets for local products. In the 1830s, the Ohio legislature adopted a law committing the state to furnish one-third of the capital required by *any* railroad company in the state. In 1852, two-thirds of the $10-million capitalization of the Pennsylvania Railroad had come from local governments. State governments often granted railroad companies the power of eminent domain, monopoly privileges, charters, exemptions from taxes, subsidies, and loans.

The federal government began doing much the same starting in the 1850s, particularly in the case of the transcontinental railroads that received low-interest or interest-free loans, land grants, and federal guarantees for private loans. However, all the government loans and guaranteed loans had been retired by 1895.

The period of extensive railroad building peaked in the 1870s. A period of intense competition followed. Railroads attempted to restrict competition by means of various agreements with local governments, industries, and other railroads. These didn't prove to be workable in the long run. Therefore, railroad officials lobbied for federal regulation. The result was the 1887 Interstate Commerce Act that, in effect, created a cartel of the railroad industry with the federal Interstate Commerce Commission (ICC) as its administrator.

With the ICC regulating prices and services, the railroads did reasonably well between 1887 and 1920. During that period, however, the ICC added new bureaucratic regulations and amendments to regulations that gradually increased the ICC's control over the ways that railroad managements ran their businesses. The Transportation Act of 1920 imposed even more stringent restrictions on railroad finances, pricing, and services. All key railroad operating decisions became subject to ICC approval. In effect, the U.S. railroads were nationalized in all but name.

However, the initial government subsidies, loans, and land grants resulted in substantial overbuilding, leading to numerous financial debacles as uneconomical companies and routes came into being and then were merged into larger and more complex route structures without improving the profitability of those systems. At first, government regulation helped the profit pictures of railroads by halting the downward trend of rates that were of dubious benefit to customers due to increased shipping restrictions and decreased services. The creation of the ICC and its bureaucratic controls froze the then-existing pattern of uneconomical, randomly organized systems and prevented the emergence of more efficient ones.

The collapse of the American railroad industry began in the 1950s. Railroad companies either merged to stay alive or went bankrupt. Long-distance passenger services, never profitable,

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were slowly dropped. Branch lines were closed. Services were suspended. The grand "union stations" in many cities became deserted shells or were demolished to make way for high-rise office buildings or parking lots.

The government takeover of the bankrupt Penn Central extended to more than a dozen railroads. Even the government couldn't make money running the railroads, as Conrail clearly showed and as Amtrak continues to prove.

Would the railroads exist today if they hadn't received government subsidies and protection? Yes, but the rate of initial construction undoubtedly would have been slower because railroad companies would have had to convince investors of the economic and financial soundness of each venture.

The Automobile

The federal government aided the automotive industry not by business risk reduction but by providing a substantial subsidy in the form of a nationwide network of paved roads. The early government support was motivated by the same reasons as the subsidization of the early railroads: low-cost access to the continent by agricultural and industrial interests.

Before the development of the automobile, roads were simple and inexpensive. Although brick paving was used on some city streets, most roads in America had graded dirt surfaces that became muddy morasses in wet weather. These roads were privately constructed and built by clearing the right of way and filling in holes. In the period 1800-1850, most American roads were privately-owned turnpikes, as toll roads were called then.

The development of the automobile and the truck changed all that. The automobile manufacturers, the truckers, and automobile owners' associations promoted the concept that the federal government should build paved roads accessible to all, a nationwide system of "free public roads" and later freeways as opposed to turnpikes. The word "free" meant "without user charges."

However, the use of the public roads isn't free. Various user taxes are levied by local, state, and federal governments in the form of fuel taxes and vehicle license fees. The users thus pay indirectly for much of the road construction and maintenance. However, psychologically, the American roads and highways became and remain "free" for public use.

At the end of World War II, U.S. Army officers saw the German autobahns. They knew that another transportation system, the railroad, had served an extremely useful role in military operations for nearly 100 years. They came to the conclusion that autobahns would do the same and that the United States should have such a system for national defense. In reality, the German autobahns hadn't contributed to the defense of the Third Reich nearly as much as to its invasion and defeat by providing good road access within the country. Actually, an American high-speed limited-access interstate highway system had been studied and designed in the 1920-1940 period. It was highly touted as a

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potential 1960 achievement in the General Motors "Futurama," designed by Norman Bel Geddes at the 1939 New York World's Fair. However, prodded by the national security justification, Congress passed the Highway Revenue Act of 1956. This established the highway trust fund to be used for the construction of the Interstate Highway System, a planned 42,500-mile network of limited-access high-speed multi-laned highways that was expected to carry 25% of the automotive traffic in the United States at the time of its planned completion in 1980. It missed the mark on both counts.

What have been the results?

Many economists have stated that separation of road use from direct payment has led to a massive overuse of roads. A perceived use price of zero leads to an enormous demand on the urban freeway system during rush-hours. This has led to an increase in air pollution in cities, which in turn has created a major revolution in automotive technology. The 1970 automobile is far different from its 1996 counterpart in terms of size, weight, engine design and size, emissions, fuel chemistry, and acquisition cost. In addition, except for 4WD and all-terrain vehicles, the 1996 auto is almost totally married to the paved free public road system.

Most freight and cargo that now moves by long-distance truck could be moved more economically and just as rapidly by rail. This would also have beneficial effects upon air pollution because of the lower total exhaust emissions from diesel locomotives versus the number of diesel-powered trucks required to transport the same amount of freight. Indeed, this is beginning to take place as more and more drive-on-drive-off trains come into use, each car carrying one or more boxlike truck trailers.

However, the automotive industry used its financial power to destroy the competing rail system.

Direct involvement by General Motors and Standard Oil in the 1930s caused the dismantling of the 1,164-mile Pacific Electric System, the world's largest interurban electric railway system in and around Los Angeles, California. GM purchased the system and substituted their Detroit-made street-operable autobuses for the "big red cars" that ran on dedicated rail rights of way everywhere in the LA Basin on frequent and convenient schedules. The electric "light rail" system that then existed was gradually replaced in the 1950-1980 period by the present-day freeway system. However, would the population growth of the Los Angeles area have overloaded the Pacific Electric System, creating the need for a freeway system anyway? Or was the population growth a consequence of the freeways?

Or should the "freeway" system have been built as a "turnpike" toll road system?

In the New York City metropolitan area, the interurban rail system survived, albeit not in private hands, because an extensive freeway system couldn't be integrated into an urban complex that had grown up around the horse rather than, as in the Los Angeles case, around the automobile.

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Many roads and highway bridges around New York City charge tolls. However, tolls don't appear to have reduced road and highway usage, especially on "the world's longest parking lot," the Long Island Expressway.

What would the highway system look like if it had been built, operated, and maintained by private enterprise instead of by government taxation? Many high-speed limited-access modern turnpikes were built. Some were converted into free roads as part of the Interstate Highway System when their construction costs were paid off, but some remain toll roads today. Would we have separate truck turnpikes built to more robust standards than passenger car highways? Would long-haul auto travel be by something similar to the Auto-Train between New York and Miami? Would we have turnpikes on which higher tolls are charged during rush hours to level out the peaking? Would highways thus resemble electric power utilities in organization, service costs, management, and funding?

Here the question must be asked, as it should be for all government-funded or subsidized endeavors: How well has it worked and have the consequences created more problems than were initially solved by government subsidization, standardization, and control? An allied question: Would it have worked out as well without government subsidization and involvement, even though it might have taken a little longer? And what might happen if the government road system were sold, in whole or in part, at public auction to the highest bidder and thus de-nationalized and commercialized or privatized?

Can a government-empowered cartel successfully and economically be disbanded and privatized for the public good? Yes. Read on.

The Telephone

The early telephone industry was characterized by intense competition in spite of extensive patent protection obtained by the Bell Telephone Company. In the 30 years following Bell's introduction of his 1876 prototype, many firms entered the telephone business. Some cities had two or more competing telephone companies, usually not connected with one another. By 1907, there were as many telephones provided by competitors—about 3 million—as there were in the Bell System.

Most competing telephone systems were not compatible. No standards existed for matching the various electrical characteristics of the telephones or their lines and terminations.

John Pierpont Morgan became convinced that standardization would allow interconnection that would broaden the market and, through takeovers and buyouts, produce a nationwide telephone system. He decided he'd create it because it would be a monopoly he could control, something he'd tried to do by forming U.S. Steel and General Electric Company for different purposes in the same time frame. His first move was to bring Bell System pioneer Theodore Vail out of retirement to run a new company, American Telephone and Telegraph Company (AT&T).

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Vail went to work to create "one policy, one system, universal service." Two key elements were required for AT&T's success: (1) creation of state public utility commissions that would grant telephone monopoly franchises and then regulate the user rates, and (2) creation of a similar federal regulatory agency and system to handle the interstate aspects of a single telephone system.

The philosophy of the Progressive Era was compatible with such financial movements because, while industry and finance could still be assured of all-powerful monopoly status, politicians and their bureaucrats got the feeling that they could exercise some populist control over these cartels. Within a decade, Public Utility Commissions (PUC) were active in most states. In 1910, the federal government brought telephone and telegraph companies under the umbrella of the ICC. The passage of the Communications Act of 1934 gave the primitive communications industry its own regulatory agency, the Federal Communications Commission (FCC).

By 1964, 30 years after the passage of the Communications Act, it was becoming obvious that the system and its various franchised companies had fallen technically behind in spite of Bell Labs. The standards were too stiff and unyielding and there was no procedure for modifying and updating the standards to embrace new technology that would have offered more capability and lower rates to users. The government-enforced monopoly of AT&T was denying customers the technology that was available in the electronics and data processing areas. Land-based microwave systems were beginning to blossom, driven by the higher bandwidth demands of television. Even the old, low-tech railroads were beginning to embrace microwave networking for rapid communications along their rail systems, creating additional capacity that the FCC would not allow them to provide commercially to customers. The early communications satellites were just beginning to offer wire-free long distance worldwide communications.

Without the restrictive regulations and rigid standards of the FCC, microwave systems would very likely have been available sooner. But federal control over communications had created a single company—alongside many smaller "competing" companies such as General Telephone and Electronics (GTE)—possessing a virtual monopoly. This also created a corporate strategy that demanded AT&T protect its enormous investment in its old long-distance cable facilities. Commercial investment in newer, better systems was therefore discouraged.

This became history with the federal anti-trust break-up of AT&T.

Today, a far less rigid regulatory environment appears to exist although the FCC still wields tremendous power and influence. Competition has returned to the telephone industry, and the new AT&T bears scant resemblance to its ancestor.

In retrospect, was the creation of a government regulatory environment and the resulting commercial monopoly really necessary in order to get standardization and interconnectabili-

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ty? Or did it delay and restrict the commercialization of new technology?

It's widely believed that the government decision to support the transcontinental railroad produced the national track gauge standard of 4' 8-1/2" between rails. However, cognizant rail historians point out that this gauge had been standardized long before because it made economic sense to have interchangeability between the equipment of various railroad companies. Railroads also originated such standards as time zones and nationwide "standard time."

The machine tool industry voluntarily developed its own standards for screw threads.

The motion picture industry adopted its own standards for such things as film size, frame rates, screen width-height ratios, and sound tracks. As improved technologies made possible such things as Cinerama, Todd-AO, IMAX, and other wide screen formats as well as multi-channel sound and Dolby, these were quickly adopted by the industry and put into standardized form.

In modern times, the electronic industry developed numerous standards ranging from the rotational speed of disc recordings to the complex standards for the present-day CDs. While some "mavericks" such as the RCA 45-rpm discs with their large center holes, Sony Betamax videotape recordings, and Apple Macintosh computer operating systems appeared and flourished, the modern telecommunications and data processing industries have been quick and eager to convene their own national and international standards-making activities. The reason is simple business logic: In a mass market economy, *no one wants to be so unique that his product or service isn't compatible with the rest of the market!* Often, it wasn't the best possible technological standard that was adopted, especially if the standard had been established while the technology was still embryonic or emerging. However, successful long-term industry standards are those that can be and have been revised, modified, and updated to allow for the accelerated pace of technological development created by private enterprise operating within the free marketplace.

Radio and Television

Commercial radio broadcasting began in 1920. By 1922, some 564 broadcasting stations were on the air. In the absence of any laws or regulations relating to frequency assignments, the airwaves were a bedlam of interference. Under a 1912 law, broadcasters had only to register their transmission frequencies with the U.S. Department of Commerce. Frequency interference conflicts led Commerce Secretary Herbert Hoover to convene a series of radio conferences between 1922 and 1925. Their general findings emphasized that the federal government should be empowered to allocate frequency use and to prevent any user from establishing property rights in any portion of the frequency spectrum. This is an extension of the belief that some things belong to the public. But this means they belong to no one and must therefore be con-

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trolled by a centralized government with people in charge who have no vested interest in the success of the endeavor. In 1927, legislation brought into being the Federal Radio Commission.

Instead of getting together and making private agreements, the radio broadcast industry conceded control over their property rights to radio frequencies and the essentials of their business to the federal government in order to achieve harmony.

The Federal Communications Commission was established in 1934 and added the telephone and telegraph industries to government regulatory control.

Protected by the FCC, the radio broadcast industry became a cartel that was cautious, conservative, monopolistic, and very profitable. The advent of television broadcasting perpetuated and increased the FCC's regulatory *and standards setting* roles. Three national networks dominated the industry and grew extremely adept at manipulating the FCC to their advantage. When pay and cable television became possible and economical, the application of these technologies were retarded by the combined power of the FCC and the networks.

Nationwide programming for a mass audience demanded program content targeted at the lowest common denominator type of audience. In the 1950s, even the FCC chairman himself derided television as being a "cultural wasteland." Free enterprise advocates failed to realize that this wasn't the result of federal regulations and control but of a government-sanctioned cartel that suppressed competition. In an attempt to enrich the "cultural wasteland," public radio and television was established and fostered by the federal government by means of direct subsidies of the Public Broadcasting System (PBS). While numerous memorable programs of high cultural value have been produced and aired by PBS, many people feel that the ideological slant of this public programming has been, by and large, far more liberal than the often-criticized private broadcast media. As one critic remarked, the federal government's attempt to enrich the cultural wasteland amounted to spreading more fertilizer on it.

When the technologies of pay, cable, and satellite broadcasting finally matured to the point where they were economically viable, the existing network cartel could no longer fend off the demands that the FCC open the gates. In 1996, the nation is still in the chaotic transition period that has resulted from liberalization of the FCC regulations and policies.

What might have happened if the federal government hadn't stepped in at all in 1927? Some mechanism to prevent frequency interference was indeed necessary. But other similar conflicts have been privately resolved in other industries without invoking the government for help or abrogating the control and standardization of an industry to a bureaucracy. The normal mechanisms for preventing and resolving such conflicts already lie in a legal system that provides for the protection of property rights. If Con-

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gress had defined property rights in the electromagnetic spectrum, made them fully transferable in the marketplace, and established means to enforce them in the courts, there would have been no need for a federal regulatory bureaucracy with vast powers to administrate and control the shape of an industry. The broadcasting networks wouldn't have become the dominating monolithic structure of the industry. Industry-developed standards would have been more responsive to changing technologies as they matured, making available high-definition TV that could effectively challenge the government-imposed 50-year-old analog TV standards, including the color standard finally determined by FCC edict in 1950. Competition and market dynamics would have shaped the industry, not government bureaucrats.

Much the same sort of thing happened when the government deregulated the airline industry.

The Personal Computer and the Internet

The development of the personal computer (PC) has been totally in the hands of free enterprise. No government subsidies, regulations, or controls were placed upon the personal computer industry save those already in place and administered by the FCC (relating to radiation of radio frequencies from PCs) and SEC (relating to capital stock issuance and trading of computer companies).

It's true that the computer industry was stimulated by government requirements. The 1880 census revealed more than 60 million people in the United States. Given the population growth rate, the Census Office determined that it would require the efforts of hundreds of clerks over a period of nearly eight years to tabulate the anticipated 1890 census data into categories of sex, birthplace, and occupation alone. Therefore, the Census Office held a competition to select a system for census tabulation.

The winner was the Electric Tabulating Company founded and owned by Herman Hollerith, who proposed and demonstrated a revised business tabulating machine using punch cards and electrical counting. (Hollerith didn't invent the computer data storage device incorrectly called the "IBM card"; the punch card was developed a century before to control Jacquard looms, and even Charles Babbage proposed using them in his unfinished analytical engine 50 years earlier.) Hollerith said he got his idea from watching a railroad conductor punch tickets.

The federal government was an early *user* of electrical counting and tabulating machines, as computers were then tagged. But this was the extent of early government involvement. All early computer development was for business accounting purposes.

However, the value of the primitive computer was recognized by federal agencies as a tool for complex computational problems. The U.S. Coast and Geodetic Survey began using early machines to calculate tidal prediction charts. But the computer wasn't extensively used until World War I. Enormous numbers of people were involved, all industrial areas became

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important, and millions of soldiers were put into the field to fight. Tabulating and statistical analysis became an absolutely necessary tool of the warring governments. When the United States entered World War I, the federal government virtually nationalized the agricultural, transportation, and industrial bases of the country under the control of the War Industries Board. This involved a massive data processing job that was quickly intensified by the passage of the military conscription law. Draftees had to have uniforms and be put into jobs they could do. These sound like trivial tasks today, but not even Sears, Roebuck and Company's mail order clothing capability had a set of clothing size standards; all mail order clothing was made by hand to measurements sent in by customers. And there were no standardized psychological or aptitude tests for evaluating the potential skills of millions of drafted soldiers. These tools evolved out of World War I requirements.

After World War I, computers were still primarily used in business. However, the U.S. Army had an interest in computing "ballistic tables" for artillery shells. The only way to get such tables was by means of hordes of mathematicians tediously making hand calculations by the thousands. The entry of the United States into World War II intensified the need for such military calculations. The war also saw the development of highly specialized analog pointing computers for anti-aircraft guns and aircraft bombsights. The development of both the electromechanical and vacuum tube "mainframe" computers later exemplified by the ENIAC, EDVAC, and (an obvious acronym) MANIAC came from calculation demands that greatly overburdened human resources. A chance meeting between Captain Herman Goldstine, who was the contract officer at Aberdeen Proving Ground for the development of the ENIAC at the University of Pennsylvania, and Dr. John von Neumann, who was working at Princeton on the Manhattan District project to build the atom bomb, resulted in the use of these large mainframe computers for scientific calculations.

In the following three decades, the electronic computer was exemplified by the huge mainframe machine using vacuum tubes or discrete components such as transistors. Then came the microprocessor. It was not developed by or for the federal government. Marcian E. "Ted" Hoff and Dr. Robert Norton Noyce, both then at Intel Corporation, applied LSI (Large Scale Integrated) circuit technology in response to a requirement for a family of computer integrated circuits (IC) from a Japanese desktop business calculator company named Busicom. Out of this came not only the CPU chip but the RAM and ROM chips plus a simple shift register chip. Busicom later regretted the contract clause that allowed Intel to independently market these chips. Although in 1969 and 1970, Intel had negative cash flow and negative income, the Intel board of directors gave the go-ahead for the development of a microprocessor based on integrating the Busicom chips onto a single chip.

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They justified their decision on the basis of data that indicated a worldwide market of a few thousand units per year. Thus was born the Intel 4004 CPU.

Modern microchip technology does indeed have its roots in work done under contract by the Department of Defense in the Very Large Scale Integrated Circuit (VLSIC) programs. However, it rests upon the foundations of the work by Hoff and Noyce who produced the first high-density integrated circuit chips in response to a Japanese requirement!

The personal computer grew from the desire of amateurs to have their own computers. Since mainframes were extremely expensive, these amateur experimenters concluded that if they couldn't buy personal computers, they'd make them. In 1976, Stephen P. Jobs and Stephen G. Wozniak raised $1,350 in start-up capital by selling Jobs's VW van and, on the basis of marketing research conducted by A.C. "Mike" Markkula, Jr., introduced the Apple personal computer. There was no government subsidy or contract. There were no government regulations. There was no government agency that had to approve what Jobs, Wozniak, and Markkula did. In 1981, IBM (the modern incarnation of Hollerith's original company) woke up and introduced the first IBM PC with an operating system developed by Microsoft and an open architecture. The rest of the story is well-known contemporary history.

Again, standards were developed by the computer industry itself. In common with many other technological products that have appeared since 1960, several competing industry standards were developed so that today the computer world is divided into Macintosh and MS-DOS users. However, other compatible standards were developed. Nearly every computer guru knows what "ASCII" means.

Connecting all these PCs together into one massive, integrated, complex, super silicon network did have its origin in the federal government. Indeed, a semi-subsidy was involved but without strings attached. In the 1970s, the Defense Advanced Research Projects Agency (DARPA, later shorted to ARPA) provided modest funding to establish an early computer network linking its contractors and many academic institutions. DARPAnet was funded by the Department of Defense. It was noticed early in this work that the DARPAnet was not being utilized to even a small percentage of its capability. Therefore, with little fanfare and certainly no specific approval from Congress or the administration, DARPA personnel invited individuals to join the network, believing that this would foster badly needed computer expertise and contribute to progress in this area. Over the years, standards were developed either among the users or by joint agreement between the users and DARPA/ARPA. As commercial computer on-line networks such as Compuserve, The Source, BIX, Delphi, and GEnie came on line and became profitable operations on their own,

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free enterprise companies providing hardware, software, and services to the growing network community joined in to establish standards. The on-line community also set up its own self-policing methods and policies. The result is today's Internet and e-mail services that link people and their organizations worldwide as never before in history.

With regard to both computers and networks, the government didn't recognize what was going on until it was too late for it to affect the technology or its use. When trial balloons relating to controls and regulations were sent aloft, these weren't shot down as much as they were simply ignored and left to drift elsewhere on the winds of time. No one approached the federal government from the computer and network domains asking for protection, subsidies, assistance, or policing. Indeed, the consensus among these groups is that such government intervention is neither needed nor wanted for fear that it would stifle the free flow of information. To date, save for the FCC involvement in wireless computer technology and network systems regulations already in place within the FCC, the federal government seems to have no role that's wanted by the makers, providers, or users. The computer and network spheres remain, for the most part, free and untrammeled.

Some government involvement may be required for the definition and protection of electronic and cybernetic property rights. This will require legal clarification and should be based on the power to decide conflicting issues in the courts rather than by the adoption and enforcement of government regulations.

Thus far, the computer and network areas provide examples of individual initiative and private enterprise working and succeeding over nearly a century without direct government subsidy, protection, or regulatory intervention. This has had its drawbacks in terms of extremely rapid obsolescence of hardware because of swift technological progress unhindered by the need to satisfy regulations or rigid standards based on old technology. An operable personal computer that is five years old is not only two generations obsolete but has practically zero junk value. The only reasons for upgrading seem to be the difficulty of getting parts, supplies, new peripherals, and better software for the older computers. Properly cared for with a modicum of attention to simple operation and maintenance procedures, a personal computer can remain useful for well over a decade.

Conclusions

The historic record seems to indicate that champions of given technologies often got the government involved when the specific technologies hadn't yet been developed to the point where they could support economical and moneymaking enterprises. In short, the entrepreneurs counted on government subsidization to bolster or allow "cartelization" of what otherwise would have been a losing business proposition. In numerous instances, this had the un-

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forseen result of eliminating free market competition.

In other cases, government involvement drastically retarded the commercialization of new technologies.

However, a few cases can be cited in which a government-industry partnership resulted in a robust competitive and progressive business arena.

Free enterprise advocates will point out that, in nearly all cases, government involvement has tended toward overregulation, government monopolization, or de facto government control of an industry.

People concerned about big business monopolies/cartels, market-based pricing, worker exploitation, predatory marketing/sales business practices, and "public-be-damned" policies make arguments that government oversight has eliminated or reduced such freewheeling free enterprise abuses.

Recent history provides an example of a totally government-controlled socialistic economy that failed. On the other side of the aisle, conservatives point out that they believe true free enterprise capitalism has never been tried at all.

Who's right? The answers are clear to conservatives and liberals alike, but these answers are rarely in agreement.

Is a balance necessary? If so, where is the balance point? And is it a static balance point or a dynamic one that must be moved as technological, business, and social factors change and evolve?

It's clear that the process of developing commercial space activities out of a former government monopoly is going to write yet another chapter in this continuing story.

How it turns out will depend on how well we've studied and learned the lessons of history. And whether or not we pay attention to the dictum, "Be careful what you ask for because you'll get it!" ■

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Pete D. Manison's first novel was written while he studied electrical engineering in his home town at the University of Houston. Scribbling away in the back row, he was sure the professors thought him a diligent note taker. Being a writer seemed much more fun than being an engineer. The 100-page, galaxy-spanning epic written in class, is now stuffed in a filing cabinet.

Having to do engineering math was daunting enough, but having to sit all day in front of a computer screen would certainly kill creative pursuits after working hours. Instead, he took jobs that left him mentally free: salesman, warehouse foreman, forklift operator, and best of all, truck driver. City delivery vans and open-road semi-trailers gave him time to think of story ideas and write by dictating into a tape recorder.

After some blind alleys, he stumbled on a basic technique: doing a 50-to-100-page outline. Having worked out the ideas, he then ignored the outline and turns out everything fresh as he goes along. Four more novels were finished before he turned 25, none of them publishable. Learning that most writers sell short fiction first, he shifted to short stories. His fifth made the finals in the Writers of the Future contest and was published in volume six of the contest anthology. Pete says the experience changed his entire perspective, especially the writing workshop conducted by *Analog* writer and contest coordinator Algis Budrys. Pete felt he had learned more in a week than he had in ten years of blind groping.

Algis taught from practical experience combined with the tenets of writing expounded in print by another *Analog* professional, L. Ron Hubbard, the contest originator. Back home, Pete was bristling with creative energy and appreciation for the short story. For three years he wrote only short fiction, and now has sold some twenty stories. These include two novelettes and a novella. He finds that inspiration and energy for short fic-

Pete D. Manison

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Pete D. Manison

NO BLOOD ON MY HANDS

"Just say no" isn't always easy. Sometimes the hard part is figuring out what the question is. . . .

Illustration by Darryl Elliott

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In her first waking moments, when dreams and reality overlapped and the world was soft and hazy, Dr. Janet Jeffries became vaguely aware of something wet and sticky on her hands. She pawed at her pillow. The smell brought her fully awake, and she stared at the dark streaks her fingers had left on the pillowcase.

Blood.

She sat up in bed and looked at herself. This had to be a dream, she told herself, because people just didn't wake up with blood halfway up their arms and spattered all over their nightgowns. Not in the real world. No, it just didn't happen.

But when she'd waited a minute or two and the dream was still going on, she began to notice the unmistakable signs of real life. A truck could be heard moving down the street, and she remembered that today was Thursday, garbage pickup day. She ran her tongue over her teeth and found a layer of disgusting residue there. And she had to go to the bathroom.

Janet looked at her hands again. The blood had begun to dry. She got up from bed and moved to the bathroom. Washing her hands, she began to notice other things: a grayish powder on the bottoms of her feet, a throbbing behind her ears, a general feeling of fatigue that made it seem like she hadn't slept at all.

A shower and two cups of coffee cleared up all these symptoms, and by the time Janet Jeffries left for the hospital the whole thing began to seem like it might have been a dream after all.

Reminder: you need to start getting out more often.

"Morning, Dr. Jeffries."

"Morning, Paul. Anything unusual on the docket for today?"

The receptionist's eyes moved over his computerized lists of appointments and notes. "No, ma'am. Two defibrillator implants, at ten and twelve, consultations till four, and I have a note saying you planned dinner with Dr. Forester at eight."

Janet blinked. "What? That man! Did he call again? Or did he send roses?"

"He called."

"The nerve. Next time hang up on him. That's doctor's orders. And call me Janet, will you? You've been my receptionist for a month."

Paul reddened slightly. "Of course . . . Janet. You know, you're looking a little tired today."

Janet smiled, slipped into her lab coat. "I'm fine," she said. "I'll be checking x-rays until that first defibrillator at ten. Buzz me by a quarter till if I'm not here."

Paul nodded. Janet went out, walking with her short energetic steps down the hospital corridor. That Fred Forester! If he wasn't questioning her skill as a surgeon he was trying to seduce her or make her look like a fool in front of the rest of the staff. Sexual harassment was what it was, but she was new at the hospital and it hadn't gone too far and . . . damn it, she was mad as hell!

What could she do? Report him and open a Pandora's box of trouble? Encourage him and end up—she shud-

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dered. Don't think it. Not with that bald, sneering fat man. Ignore him. Hope he'll go away.

"Janet! I was hoping I'd bump into you this morning."

She turned.

Suddenly, she felt sick to her stomach.

Reminder: get rid of that "sexy perfume," and avoid the corridors near the x-ray lab whenever possible.

The next morning, Janet awoke in confusion. Something about a dream, about smoke and fire and . . . blood. She looked at her hands.

"This is getting weird," she grumbled. She cleaned up and sat down to look herself in the eyes in the steamy bathroom mirror. Something was going on here. What? She tried to remember the feeling, like standing somewhere amidst loud noises and acrid fumes and anguished *screams*.

She gasped. The image was so *real*. A dream. Yes, surely a dream. No, not a dream. Physical traces. Two consecutive nights. Somnambulation? And what? Murder? The thought so terrified her that she went out, picked up the paper off the front lawn, and scanned it for mysterious attacks or deaths. Nothing. Quiet all week. *Less* than the usual amount of violence.

Blood on her hands two days running.

She went to work.

Reminder: talk to Dr. Cisneros about "dreams." Don't mention the blood.

The next day was horrible. She almost lost two patients, both on what seemed routine operations. Both were easily explainable as unavoidable complications, and she brought one back so miraculously that the anesthesiologist actually congratulated her afterward and said he'd never seen such fine work. But inside, Janet wondered. She felt awful. Maybe she was coming down with something. Maybe she was cracking up.

Forester cornered her again, this time in the elevator as she was heading to the parking garage at the end of the day.

"So," he said through his usual jowly smirk, "are we on for tomorrow night?"

Janet blinked. "Excuse me?"

"I called your receptionist, but I guess he hasn't been giving you all your messages. I wouldn't trust that boy, Janet. He reminds me of a guy I used to room with in med school: innocent as hell on the outside, but a scheming bastard underneath. Don't let a guy like that ruin a potentially meaningful—"

The elevator stopped, and the doors opened.

There *was* a god.

"Sorry, Fred," she said quickly, stepping out and glancing around and spotting, thankfully, several other doctors and nurses in the parking garage. "I don't want to go out with you. Not last night, not tomorrow night, not ever. I hope I've made that clear enough. Now, if you'll excuse me, I'm very tired, and I'm going home."

He stared after her. She could feel his eyes, feel the heat from them, but

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when he called out it was with his usual false joviality. "Sure, Janet. Maybe some other time, then."

She kept walking.

Reminder: what? Stop washing? Hedge trimmers? Christ, I need some rest. But do I dare sleep?

By the seventh time she'd awoken in bloody sheets, Dr. Janet Jeffries had become convinced that she was either going the schizophrenic hallucination route or she was the victim of malevolent, small-bodied aliens who abducted her into their spacecraft every night and performed bizarre surgeries on her body and then erased her memory before returning her to her bed each morning. One of the two, had to be.

What was certain to her was that she could not continue to work—to take the lives of trusting patients into her hands—under these conditions. Every muscle in her body was sore, she had unusual aches and pains, and it felt like she hadn't slept in a month. Her hand was steady when she held it out before her that seventh morning, but she knew better than to trust it.

She got on the phone.

"That's right, Paul. A very nasty virus. Wouldn't want to take any chances. Yes, yes I'm on antibiotics, and don't worry, I'll be fine. I just can't risk spreading the infection. Exactly. Just take all my messages, tell them I'm unavailable for the next several days, and I'll check in with you regularly. But Paul? Call me if there's an emergency with one of my patients. No one knows them the way I do. Sure, I'll do that. Thanks. Bye."

Janet hung up the phone. She hated lying, especially to Paul, who seemed like such a nice kid. But she needed time to think this thing out, and the truth, if reported at this stage, could wreck her career.

She shivered. It sure had been getting colder these last couple of days. In July, to have the heater on? She turned it higher, though, because she was cold, as if her innards were made of ice.

The recorder. That was what she'd been trying to remember. The video recorder her neighbor Bruce had agreed to loan her, no strings attached, he'd said with his blond, mustached smile. She'd slept with Bruce several times, but as always her work dominated her life and drove him away, or drove her away, or did whatever it tended to do, which she'd never really been able to figure out.

Another cup of coffee.

The camcorder! He'd left it just inside the door (still had his key, did he?). She checked the camera out. It was a tiny thing, no larger than a deck of cards, the very latest in microtechnology. When everything worked she set it on the chest of drawers in her bedroom so that it covered the entire length of her bed.

I never thought I'd be doing this kind of film, Janet thought tiredly that night as she removed her clothes before the camera, put on her nightgown, and got into bed. The red light on the camcorder kept her awake ten minutes longer than usual, but, finally, she slept.

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Reminder: copy tape segment with unexplained image sequence. See if Bruce knows how to slow down or enhance.

"No, Fred, it's not tuberculosis or St. Louis encephalitis. It's just a . . . bug. I think that's the technical term. But thanks for calling, really. I've got to go now, I'm very tired. No, I'm not angry with you. No, I don't need anything. No! I just need some rest, OK? Look, Fred, I'm not feeling well at all. I'm sorry I snapped at you. Will you cover my patients until I get back on my feet? Thanks. Yes, it is. Bye, now."

Janet slammed the receiver down a little too hard. That man! When would he give it up? Dr. Fred Forester might be the most brilliant heart surgeon in the state, but he didn't know the first thing about women. It seemed ironic to her now that she'd requested the recent transfer primarily in the hopes of learning under the tutelage of a man she had known, then, only by reputation.

She only wished it had stayed that way.

Now she had a headache, and she was so tired she could feel every muscle and tendon straining tight through her entire body. Yet the images on the television screen held her mesmerized. Time after time, she replayed the crucial seconds, the clock in the background of the frame clearly showing the time as 1:01 A.M.

And then the flash.

And the empty bed.

And, a long time later, the tape running out.

Damn, she thought. The tape was too short to record a whole night.

But something! Something! Now she knew it was real: the camcorder couldn't suffer hallucinations. Unless she was hallucinating the image *recorded* by the camcorder. . . .

No, she told herself, stop it. Stop running away from the truth.

Janet had been busy. She'd analyzed the blood samples she'd begun saving after the second morning, and had determined that all the samples were human blood. Most mornings, she could represent every known blood type, plus one recurring one she'd never seen before.

Still, she told no one. When Paul called because she'd missed one of her regular check-ins, she told him she'd been sleeping. And when Bruce came by to help her with the camcorder, she kept her distance, perpetuating the viral deception. He showed her how to hook the recorder to her PC and further enhance the images, but she didn't play the tape in his presence, even though his curiosity (about more than one thing) was obvious.

An hour later, Janet knew she'd have to bring someone else into this before long, whether she liked it or not. For while the enhanced images were blotchy and difficult to interpret, the dark, moving forms and the bright orange flashes made her feel threatened. There was something menacing about that half-second glimpse, as if somewhere things were happening at a frenzied pace, and vast energies were being released.

"Not yet," she said aloud, startling herself. No, she couldn't trust anyone

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else—not yet. She needed more information. The tape from last night showed a window.

Janet decided to look inside.

Reminder: don't be afraid. Whatever's happening has been happening for a week, and you're still alive. Going crazy but still alive. The only thing that's different this time is the camera. Question: then why am I still afraid?

The next morning, when Janet awoke, there was blood on her hands. But this time there was also blood spattered on the camcorder she'd clipped to the front of her nightgown.

Her head hurt even worse than usual as she went through her morning cleansing routine (as always, worrying about the chance of disease contagion from the blood). But she found herself humming as she toweled off. When she came out of the bathroom, the camcorder on the bed seemed to glow with importance. She teased herself, waiting long enough to make coffee and eat a granola bar. Then she could wait no longer.

PLAY.

The first hour of the tape showed nothing but darkness.

FAST FORWARD.

STOP.

PLAY.

The second hour was the same, except when she turned and the lens picked up the fuzzy blue outline of a pillow.

FAST FORWARD.

STOP.

PLAY.

And the third—blackness. She was beginning to fear the tape had been too short again, or the recorder had malfunctioned, or that this time, this one time, it hadn't happened (though there was the blood . . .) when a bright white light exploded across the screen.

Long, dark shapes scissored forward, and the camera frame jerked to the side and down. At that angle, all that was visible was a gray, soot-covered surface bright with reflected, actinic light, and, enigmatically, two booted feet. The boots were glossy but worn, and the stance of the feet seemed unnaturally rigid.

They were big feet.

Then the camera bounced and a blur of gray shapes flashed by: blocky and angular but crumbling, like sand castles at high tide. Twice, a different shape, faster, flashier, crossed the field of view, but the light source, white and harsh, was confusing the camera's electronics. The image came out flat and colorless, like looking at a negative.

Then the motion stopped.

A shadow crossed the camera, and then a tall, slender form stood out in the foreground. The man was in his forties, with streaks of gray in his sideburns and a face so rugged it made the sharp, darting eyes seem out of place. There were depths in those black, liquid eyes—depths of suffering and desperation and hopeless hope.

PAUSE.

"What the hell is this?" Janet crawled down onto the carpet, right up to the screen. The man was real

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enough. He was wearing some kind of military uniform. He was looking at something slightly above the camera, but then, coldly, Janet realized that if the camera hadn't been jarred loose from her nightgown, the man was looking *at her face.*

Fear suddenly made her freeze inside. Something about that man was . . . familiar. For several seconds she was paralyzed, unable to even think, just remembering a feeling of being cold, both inside and out, colder than a dead person.

Finally she snapped out of it.

PLAY.

Now the man's lips were moving. Janet suddenly realized the images were silent. Had she missed something on the camera? She turned up the volume, but there was only a soft hissing punctuated by patterns of faint clicking noises.

The man finished speaking and then the landscape was bobbing up and down in a way that told her she was walking. This continued for a time, with figures scurrying by and more of the big, lumbering shapes, and even, sometimes, a flash from the sky where something swift and metallic reflected that unearthly white light.

Presently, they reached their destination.

The madness began.

For three more hours, Janet watched the impossible images. Those were her own hands on the screen, no doubt of that. Their movements were too practiced, too familiar. Heart bypass. Kidney transplant. Amputation. One after another, the patients flowed beneath her busy hands. Shrapnel. Burns. Smoke inhalation. One after another, the procedures were performed. Cut. Remove. Stop the bleeding.

The bleeding. . . .

Once, a patient wearing mirrored sunglasses passed beneath her, his abdomen torn open and half his intestines gone. All she saw was her reflection in the sunglasses, her white, bloodless face, her empty black eyes. . . .

The tape shut off.

Janet jumped.

For a long time after that, she sat there, staring at the empty screen, hugging herself and rocking slowly, forward and backward, on the floor.

Reminder: start reading these reminders.

"OK," she said, pacing up and down in the living room of her apartment. "This is all under control. It's under control. This is some kind of misunderstanding. Yeah, that's what it is. Some kind of dream. No! It's not a dream. It's not a dream."

She wasn't sure, later, how long she muttered on like this, pacing up and down in front of her audience, which consisted of a Styrofoam head wearing a blonde wig Janet had never worn and with painted, smiling red lips.

The dummy head never answered her, which she found reassuring.

In time, she began to wind down. Her frenetic outburst had been the crucible in which she'd burned away

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all the impossible explanations, and she'd been left only with the possibility that what was happening to her was real.

"What *is* happening?" she asked herself, sitting now on the living room floor in the gathering gloom of dusk. She didn't turn on the lights, but just kept sitting there, staring, not at the world around her, but at something buried deep within.

Someone was using her!

Somewhere, somehow, she was being forced to perform operations on wounded men and women. The peripheral details were blurred, like *what* men and women and *what* place, but she found she could now focus quite clearly on what *she* was doing in the "vision." And on the man. Those crafty, darting eyes, that uniform, the way the others deferred to him.

His eyes.

Forget.

Janet blinked. She'd almost dozed off there. She got up, her legs stiff, and was surprised when she looked at the clock and saw how late it was.

Almost bedtime again.

Almost time to go back to that place of death and light and cold. It would be a night like any other. Or perhaps not. This time she carried a weapon of her own. Knowledge.

Reminder: if you aren't *going to read these reminders, stopping making them. There. This is the last reminder.*

Crack-*boom!* The thunderclap shocked her awake, and she opened her eyes onto a harsh white light so painfully bright it made her eyes water. She was on her feet in an instant.

It was so *cold.*

When the initial sound had dissipated, Janet became aware of a high background noise level. People were shouting and screaming, and explosions off in the distance or rarely—and loudly—nearby, punctuated the hubbub. There was another sound, too, a high-pitched whine she was sure she couldn't really hear. She could feel it, though, making her fillings and eyeballs vibrate, making her insides clench up with anxiety.

At last, her eyes began to adjust to the brightness. Bold black shadows were scissoring toward her. Hands were reaching out. A man was coming up in front of her.

"You!"

It was the same uniform, the same pockmarked face, and especially the same black, liquid eyes. But his expression now was different from on the tape.

He was surprised.

"You . . . know me?" he asked carefully.

Janet shook off the soldiers, who had been loosely holding her arms.

"I seem to have this recurring nightmare where you force me to operate on wounded soldiers. Only it's not a nightmare, is it?"

His expression showed appreciation, even respect. "Actually, it *is* a nightmare." He shrugged, looking up at the bright white fireball that hung motionless in the heavens and the other lights, dimmer, that streaked across the sky or curved in their

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smooth orbital arcs. "Sometimes I wonder if we'll ever wake up."

"Who *are* you? And what the hell are you doing to me?" He'd shown a weakness, and Janet wasn't going to miss the opening. She knew men. This might be her only chance.

But he tightened up, his eyes growing cold. "I am General Richland of the Alphacorp Marines. Forgive me for the lapse in etiquette, but it seems we've been repeating this conversation with little variation every night for the past week."

Janet shivered.

"Here, ma'am," one of the solders offered. It was a transparent garment that felt like plastic but brought her a surprising feeling of warmth.

"Well, *you* might have had this conversation with *me*," Janet said, determined to hold onto her original fury, "but I seem to be having this strange difficulty with my memory."

Despite himself, General Richland smiled. "I'm sorry about that, Captain Jeffries, but you're vital to our cause. I had no choice but to keep you ... in the dark."

"What was it? Hypnosis?"

He shook his head. "A new drug. It induces a fugue state and alters your metabolism to allow you to work longer without fatigue. I guess it was the blood that gave us away. We couldn't control when the timescoop snapped you back. Now please, Captain, we need—"

"*Captain?* That's twice you've called me that. What the hell are you talking about?"

"Oh, it's only honorary, I assure you. In your absence, the men and women you've treated have recommended the designation 216 times. A commanding officer has to go along with the wishes of his soldiers, you know."

He was so *likable*. Not at all like the image she'd painted of him from the few frames of the film in which he appeared.

"Look," Janet said, "I'm a little confused right now. And if this keeps up, it's going to kill me. So would you please just explain what this is all about?"

Richland gestured for her to follow, and he spoke as they walked. "Our war with Sigmacorp has gone on for so long we no longer have citizens or professionals or even leaders, above troop level. But the fight goes on. The enemy has blinded us with an artificial sun that brings no warmth and has devoured half our continents with Von Neumanns, but we keep fighting, adapting, trying anything we can think of to stay alive."

"No professionals? Meaning. . . ."

"Right. No doctors. Not in my troop, at least. The enemy perfected a viral weapon that singled out the brightest of us and attacked their neural tissue. A few of us were away on surveillance runs when it happened. We came back to find our best scientists and all our doctors reduced to drooling morons. We've managed to engineer a new resistant blood type, but meanwhile—"

Janet frowned. "—You needed—"

"You. We've managed to scoop you up, so to speak, from the past. It was

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a freak of luck, really, that the timecaster was able to locate you—and he had to search for a long time at that. But now we have you. And we're not letting you go."

This last made her stop walking. "But every morning you return me to my bed."

Richland nodded. "The timescoop is like a rubber band. After a few hours, it snaps you back into your time and place of origin. Only if the target space were occupied during your absence would you be able to remain here indefinitely. And so far we haven't worked out how to—"

"Hey," she blurted, feeling a pressure behind her eyes, "look here a minute. Don't I have any—" And then she stopped, because a hovercraft was drawing up to them, and the soldiers heaped upon it looked like they had been mauled by tigers.

"My God," she gasped.

Richland gestured the hovercraft driver to settle where he was. He gestured again, and Janet followed without thinking. Then the hovercraft resumed flight.

"What happened?" she heard Richland ask, his mouth close to the pilot's ear against the rush of the wind.

"Nanotechnics, General," the pilot screamed back, his voice awful. "Self-replicating flesh-eaters. We found the control frequency and deactivated them, but not before. . . ."

Janet looked at the nearest one. In a dozen places, it looked like tiny insects had eaten away the man's skin and muscle down to the bone. The wounds were dirty and infected.

She felt like fainting.

"Here we are," Richland said. They'd landed; he had his hands on her shoulders, and she realized she had fainted.

And she realized something else. They had arrived at the field hospital, and she had work to do.

Reminder: I'm all for saving the world, but this is killing me. I have to get some rest. There has to be a way out.

The phone rang, waking her up before two that afternoon. It was Paul.

"Janet, I thought you should know, but I hate to bother you, but you said that if—"

"Paul," she said gently, "what is it?"

"It's Mrs. Caldwell. She went into cardiac arrest last night. Twice. The second time they didn't think they were going to bring her back in time."

Janet nodded. "I'll be right there. Have her prepped for surgery."

"But Janet, you're sick and all and Dr. Forester said he'd—"

"No. Mrs. Caldwell is my patient. Don't worry, Paul. It'll be all right. Now do what I said."

She hung up and got dressed.

Then she went to the hospital.

Mrs. Caldwell had failed to respond to the third drug Janet had tried for preventing her heart from stopping. They'd used up all their chances and it was time to implant a defibrillator to shock the heart back to life whenever it began its downward spiral. Routine operation, success rate 98 percent.

Today it was touch and go. The nurses and technicians seemed to be watching her, noting the circles under

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her eyes and how red the eyes themselves were. At one point she became convinced, irrationally, that they knew, that they were all somehow not real people but invading aliens taking human form to watch and study her. They could read her mind but she couldn't read theirs.

Crazy. Paranoid. Another sign of growing fatigue.

Got to rest.

Then, to top it all off, Dr. Fred Forester cornered her in the corridor to the parking garage after she'd scrubbed up and was trying to sneak back out to her car.

"Hey, Janet, it's great to see you. Feeling better, I hope?"

She eyed him silently. Her head hurt. She thought suddenly there was blood on her hands, yes that there was blood on her hands, though she'd just gotten scrubbed up.

Rest. . . .

"Look," Dr. Forester said, lowering his voice, "I hate to be the one to tell you this, because I like you as a person and I think you're a damn good doctor. But Janet, people are starting to wonder. About you. Your behavior these past couple of weeks has been—"

"My behavior, Dr. Forester, is my own concern. As is yours."

"Think you're hot stuff, don't you?"

"Pardon me?"

"Nothing. I just thought you'd realize that with the senior surgeon supporting you, your career would be a lot safer. There are people here who—"

"Fred, this is sexual harassment. Now, look. I am tired. I am going home. Thank you for your concern. Good night."

She turned sharply and started walking. A hand dropped onto her shoulder and she spun, slapping him hard before she could check the reflex.

He barely flinched. "I'm not playing around here, Janet. There's a meeting tomorrow among the top hospital staff. A meeting about you. I'm going to be at that meeting. In fact, I am going to be the principal witness. And I am going to make sure you never work in this hospital again."

"You—"

Janet bit her tongue. She wanted to kill him. Slowly, with her bare hands. *She was so tired!* She wanted him out of the way, vanished without a. . . .

It clicked.

She cleared her throat, sighed. "Fred, I had no idea this meant so much to you."

His eyes widened slightly, then, slowly, he smiled. "Oh, but it does."

Eyes downcast. "Look, I'm sorry for being such a bitch these past few days, but I'm very tired. You understand?"

He nodded. "Tired people should be put to bed by competent health care professionals."

She smiled.

It was easy from there.

Reminder: not ever again.

Fred Forester snored. Which figured. Janet waited until the fat bed hog was soundly asleep before she slipped out of the covers and tiptoed across the room. His clumsy attempt at lovemaking had been a joke, and far from satisfying her, he'd actually annoyed her. But it had been worth it.

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Now, she put on a kettle of water and made a cup of hot tea. She looked at the clock. A few minutes later she looked in through the bedroom door. When the bright white flash came, she smiled.

Then she piled everything she could find on top of the empty bed.

"Fred Forester," she said, "meet General Richland. He's a brilliant surgeon. General. In fact, he's the best there is. And he's all yours."

Reminder. Rearrange furniture. Put chest of drawers where bed used to be. Stack boxes on top. Don't ever take them down.

Paul beamed when she walked into her office the next morning.

"You're looking very nice today," he said, blushing. What a cute kid.

"Thank you, Paul. I feel much better today. Any messages?" She crossed the room to her desk and picked up her patient charts. She was so nervous that she bumped her knee against the desk, bringing a sharp pain and making everything on the desk rattle.

"Are you kidding?" said Paul. "You have forty-two thousand messages, or thereabouts. Don't worry. They've all been responded to, and your charts have been updated as of 4:00 A.M."

Janet smiled, trying to let the tension flow out of her. "You're so efficient, Paul. I almost think you could run this place without me."

He grinned. Perhaps he wasn't really so awfully young at that.

"By the way," Paul said, frowning slightly, "you haven't heard from Dr. Forester in the past twelve hours, have you?"

Her heart skipped a beat, but she shook her head casually. "Thank God, no," she said, making sure to avoid eye contact. "Why do you ask?"

But Paul was already flipping through charts and records on the computer. "I'm sure it's nothing. His receptionist called me. Seems he missed all his morning appointments and doesn't answer his phone. No one's seen him since yesterday afternoon."

Janet smiled to herself. "Maybe he's off somewhere moonlighting," she said.

Paul looked at her oddly for an instant, but then he moved on to something else, and Janet sighed. She started to relax when she suddenly felt something wet and sticky on her hands. She looked down.

One of the charts she was holding had a dark, still wet coffee stain in one corner. Glancing at the desk, she saw that she had sloshed coffee all over her papers when she'd accidentally kicked the desk. She laughed, rubbing her fingers together. Paul looked up.

"Something wrong?"

For a long moment, Janet stared into space, her mind far away, but then, finally, she blinked and smiled.

"Here," said Paul, "let me clean that up."

She waved him to stay where he was. "I've got to do *something* around here. Besides, I'm perfectly capable of cleaning up my own messes."

He grinned at her as she blotted up the coffee. "And to answer your question," she said, "no, there's nothing wrong at all." ■

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Kevin J. Anderson & Rebecca Moesta

ORPHANS OF EDEN

Victory Days

Well, what would *you* have done?

Begin at the front part, Spider:

It was just after two in the morning. I was right here in my office (as we call the dining room in this family), about to write a science fiction story called "Orphans of Eden" on this loyal senescent Macintosh, when he *appeared* in the doorway from the kitchen, right next to my Lava Lamp. I don't mean "came through the doorway and stopped"; I mean he appeared, in the doorway. He sort of shimmered into existence, like a *Star Trek* transportee, or the ballplayers disappearing into the corn in *Field of Dreams* in reverse. He was my height and age, but of normal weight. His clothing was crazier than a basketball bat. I never did get the hang of the fashion assumptions behind it. I'd like to say the first thing I noticed about it was the ingenious method of fastening, but actually that was the second thing; first I observed that his clothing pointedly avoided covering either genitals or armpits. I kind of liked that. If you lived in a *nice* world, why would you want to hide your smell? He stood with his hands slightly out from his sides, palms displayed, an expectant look on his extraordinarily beautiful face. He didn't look afraid of me, so I wasn't afraid of him. I hit command-S to save my changes (title and a handful of sentences) and forgot that story completely. Forever, now that I think about it.

"When are you from?" I asked him. "Originally, I mean."

I'm not going too fast for you, am I? If a guy materializes in front of you, and you're sober, he *might* be the genius who just invented the transporter beam . . . but if he's dressed funny, he's a time traveler, right? Gotta be. *Thank God the kitchen door was open* had been my very first thought.

He smiled, the kind of pleased but almost rueful smile you make when a friend comes through a practical joke better than you thought he would. "Very good," he told me.

"It was OK, but that's not a responsive answer."

"I'm sorry," he said. "But I can't say I think a lot of the question itself. Still, if it really matters to you, I was born in the year 2146 . . . though we didn't call it that at the time, naturally. Feel better, now?"

He was right: it hadn't been much of a question. Just the only one I could come up with on the spur of the moment. But I thought it small of him to point it out. I mean, what a spur—what a moment! And the information was mildly interesting, if useless. "You don't go around pulling this on *civilians,* do you?" I asked irritably. "You could give somebody a trauma."

"Good Lord, no," he said. "Why, half the other *science fiction writers* alive now would lose sphincter control if I materialized in their workplace like this."

It was some comfort to think that my work might survive at least another 155 years. Unless, of course, he had run across one of my books in the middle of next week. "That's because they think wonder is just another

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tool, like sex or violence or a sympathetic protagonist."

"Whereas you know it is a religion, a Grail, the Divine Carrot that is the only thing that makes it possible for human beings to ever *get* anywhere without a stick across their ass, yes, it shows in your work. You understand that only by putting his faith in wonder can a man be a moral being. So you're not afraid of me, or compelled to disbelieve in me, and you probably hadn't even gotten around to trying to figure out a way to exploit me until I just mentioned it: you're too busy wondering."

I thought about it. "Well, I'm sorry to say I've been wasting a good deal of time and energy on trying not to look stupid in retrospect—but yes, most of my attention has been on wonder. Before we get to the question and answer section, though, what's your name?"

"Why?" he asked. "There's only one of me."

"Suppose I want to swear at you."

He gave a smaller version of that faintly annoying smile. "Good point. My name is Daniel."

My wife's ex-husband is named Daniel. Also amazing, also faintly annoying at times. "Would you mind if I went and woke up my wife? She'd be sore if I let her sleep through this." Jeanne enjoys looking at very beautiful men. Obviously. Our teenager, on the other hand, would doubtless find a two-hundred-year-old grownup five times more boring than me—and enough music to wake her (the only thing that will do the trick) would probably also wake the tenants downstairs in the basement suite. "And would you care for some coffee?"

He shuddered slightly—then saw my expression. "Sorry. That was for the coffee, not your wife. Imagine I brought you back to a Cro-Magnon's cave, and he offered you refreshments."

My turn to apologize. "Sorry, I wasn't thinking."

"As to Jeanne . . . please don't misunderstand. I would be honored to meet her under other circumstances, another time. Your collaborations with her are even better than your solo work." I nodded strong agreement. "But if I correctly decipher her input therein, she is a Soto Zen Buddhist and a sentimentalist."

"What's wrong with that?" I demanded.

"Nothing at all. But I seek advice on a practical matter of morality . . . and *you* understand how omelets are made."

I frowned. "Do you mind if the Cro-Magnon has a little cup of jaguar blood to help him think?"

"This is your house," he said simply.

Well, actually it isn't—I'm a writer; I rent—but I knew what he meant, and agreed with it. I thought about that while I turned another cup of water into dark Tanzanian magic and spooned in sugar and whipped cream. By the time I tipped the Old Bushmill's into the coffee my Irish was up. "Before we start," I said.

"Yes?" He was watching my preparations with the same gravity I'd like to think I could bring to watching an autopsy.

"You have managed to be sufficient-

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ly interesting that I will forgive you this once," I said. "But if you *ever again* drop in without phoning ahead first like that, I'll set the cat on you."

He did not quite look wildly around. "Do you have a cat?"

I winced. Smokey was killed a month ago, by some asshole motorist in a hurry. One of the best masters I ever served. "I'll get one if necessary. And I don't want to hear any guff when you reach my answering machine, either. It's always on. People should be grateful I let 'em leave messages."

"Understood and agreed," he said. "And I apologize. But in my defense: what would you have done if I had left a phone message?"

I nodded. "That's why I forgive you this once." I made one last try at hospitality. "I can offer you charcoal-filtered water."

"Thank you, no."

I pointed to a kitchen chair, and took the one across the table from it for myself. He sat beautifully, like a dancer, or one of Jeanne's Alexander Technique students.

I took a long appreciative sip of my Irish coffee. "I'm listening, Daniel," I said.

"Before we start."

"Yeah?"

"When will you begin to get excited?"

"About a minute after you leave, I hope. By then I can afford to."

He nodded. We both knew I was lying; the cup was trembling. He really was trying to be polite.

Why was he trying so hard to be polite?

"You spoke of wanting my advice on a practical matter of morality," I went on. "Is this an ends-justifying-means kind of deal?"

I had succeeded in impressing him. "You have succeeded in impressing me," he said. "Yes."

I sighed. "You've read *Mindkiller*."

He nodded.

It's one of my scarier books. One or two critics, after having had someone literate summarize it for them, have declared that it says the end justifies the means. Beginning for the first time to be a little scared myself, I said, "And have you got the secrets of mindwipe and mindwrite?"

"Oh, no," he said convincingly enough to make me relax again.

"What's holding things up?" I asked. "I expected that stuff to come along well before 2040."

"You vastly underestimate the complexity of modeling the brain."

I nodded philosophically. "It's going around these days. Well, I'm relieved, I guess. I had to force that happy ending. That happens to me a lot in the serious books."

He nodded again. "But you keep doing it. Splendid."

"Thank you." The better the flattery, the warier I become. Back to business. "Then I am to assume that you have another moral dilemma, as sharp as the one faced by Jacques in *Mindkiller?*"

"It is to me. I want you to tell me if I am a monster . . . or simply a victim of my inability not to ask the next question."

"Or both," I pointed out.

"Or both," he agreed.

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I took another long gulp of Irish coffee. I've long since worked out to my own satisfaction the one about a writer's responsibility . . . but I'd always known that book would come back to haunt me one day. "Let me get this straight. You have already done — whatever this thing is. Some would call it monstrous. And now you want my opinion on whether or not you were right to do it. Why? Since it's too late."

"I need to know if I dare go public—in my own ficton, my own space/time. If I can't persuade you, I can't persuade anybody."

I always had the sneaking idea I'd make a good judge, if only there weren't so damned many laws. Time to find out if I was right. "First tell me your ends. Then your means. If you can do it that way."

"I can approach it that way," he said, "but the ends imply the means. I can put it in a nutshell. I wanted to do meaningful sociological experiments."

I understood him at once, because he was speaking to the heart of the science fiction story I'd intended to write. But in case I only thought I understood him, I dragged the exposition out of him like a good character should. "What do you mean?"

"I think you suspect," he said. "Most of the really important questions about human societies are unanswerable because you can't contain the size of the question. You can't understand the ancient Romans if you don't know about all their neighbors and trading partners and subject peoples, and you can't really grasp any of them any better because they all influence each other helter skelter—and you can't even get a start on any one of them until you know their whole history back to their year one. It's the history that's even worse than the local complexity: so much of any society is vestigial, the original reasons for its fundamental assumptions forgotten.

"And it's the history that always gets in the way of trying to make things better. Look at your own contemporary ficton. Can you imagine any solution to the Irish problem or the Serbo-Croatian problem or the Palestinian-Jewish problem or any one of a hundred others like them that does not involve giving everyone involved mass amnesia and erasing all the history books?"

"Well, yes," I said. "But it won't come soon. Now that you tell me telepathy isn't even going to be as easy as time travel."

"For all I know telepathy could come along before 2300," he said. "I left in 2292," (I calculated without much surprise that he was at least a hundred and forty-four subjective years old) "and one of the limitations of time travel—a blessed one in my opinion—is that you cannot go further *forward* in time than you have already been. The only way to see the future is to live it. But I'm not expecting telepathy soon—then/soon—either."

I finished my coffee. "I'm sorry to hear that. Still, there's no real hurry. Once we have telepathy *and* time travel, we can build heaven or a reasonable facsimile retroactively."

"As in your book *Time Pressure*," he agreed. "But since I don't expect that soon and can't depend on it ever, I'm trying to save the human race in a dif-

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ferent way. There is some urgency about the matter. When I come from, we have come very close to destroying ourselves in catastrophic warfare."

"Nanotechnological?"

"Worse. I strongly advise you to leave it at that."

I could not suppress the shudder . . . or the squirm that followed it. I had been wondering if he was too evolved to have immunities for primitive local germs—just wondering, not worrying, as I believe a man's health is his business. Now I was reminded that there are circumstances under which a man's health is your business. Was Daniel carrying anything?

Too late to worry now. "What kind of a ficton is it?"

He hesitated. "It's hard to give you a meaningful answer. Imagine I'm a Cro-Magnon. Tell me: what's your world like?"

"Giddy, with fear and pride and guilt and shame, but trying to be as decent as it can."

He nodded thoughtfully. "OK. In those terms, the 2290s are sullen, scared and preoccupied with the present. In the immediate past is horror, and just beyond that are the things that inexorably brought it on us, and still we prefer not to think overmuch of the future. We see what went wrong, and don't know how to fix it. As near as we can see, all the future holds is another slow painful climb to the pinnacle which blasts all who stand on it, and those of us who think about that wonder what's the point. So not many of us think about it."

I was more grateful than ever to have lived my life in the twentieth century. But I was also puzzled. "It's hard to square that with your clothes. That kind of outfit in that kind of world doesn't ring true. People like that would cover up."

He smiled sadly. "These clothes were designed elsewhen."

Skip irrelevancies. The night was old. "OK. So what do you figure to do about your situation?"

He clasped his fingers together before him on the table. With his spine so straight, it made him look as if he were praying. "It's all the history, you see. The weight of all that history, all those mistakes we can't ever undo or forget."

"I can understand that."

"Probably you can; the problem is just now beginning to become apparent. Time was when the maximum length of history was the number of stories an old man could tell before he died. Then we got too damned good at recording and preserving the stories. At about the same time there began to be too many stories, and they all interacted. And then came the Information Explosion. Human beings are only built to tolerate the knowledge of so much failure and tragedy. All the things we've ever done to warp the human spirit, from making wars to making gods, are there in us, at the root of anything we plant, at the base of anything we build. When you try to start all over again from scratch, you find out you can't. Your definition of 'scratch' merely defines the direction history has warped you in, and condemns you to tug in the other direction. But the weave is too complex to straighten.

"It's too late for us to start over. It's

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too late to try and create a society without taboos: the people who would try it are warped by the knowledge of what a taboo is. It's too late to try and create a society without sexual repression: the parents inevitably pass along to their children at least warped shadows of the repressions they inherited themselves. It's too late to make a society without racism . . . and so on. Every attempt at an experimental Utopian community has failed, no matter how hard they tried to keep themselves isolated from the surrounding world. Sealing yourself up in a self-sustaining space colony and smashing all your comm gear doesn't help. It's just too late to experiment with a society that has no possessions, or conformity, or tribalism, or irrational religions—all possible experimental subjects are compromised by their knowledge of human history. What's needed is some way to put an 'Undo' key on history."

"I think I see where you're going," I said. "I was just about to write a story about—"

"I know," he interrupted. "And you were going to screw it up."

We'll never know, will we? "Go on."

"Well, I think you know the only possible solution. Let's do a thought experiment—I *know* you won't mind the pun. Hypothetically: put a bunch of preverbal children—infants, for preference—in a congenial artificial environment. Plenty of room, plenty of food for the taking, mild climate, no predators, an adequate supply of useful materials and appropriate technology for later. Immunize them against all disease, and give them doctor-robots that will see them into adulthood and then fall apart. Provide AI packages to teach language skills and basic hygiene—both carefully vetted to be as semantically value-free as possible—"

"Have the AI design the language," I suggested.

"Yes. Open-ended, but with just enough given vocabulary to sustain a complicated thought: let 'em invent their own. A clean foundation. When they're ready to handle it, have the machines teach them the basic principles of mathematics and science, using numbers rather than words wherever possible, and just enough philosophy to keep them from brewing up organized religion. And *not a damned word of history*. Then you go away, and come back in a thousand years."

"To find them knifing each other over which one has the right to sacrifice a peasant to the teaching machines," I said.

"You are not really that cynical."

"Of course I am. Why do you think I have to keep writing those happy endings? You know, another writer wrote a story years ago with the same basic theme as your thought experiment—"

"Yes," he said, "and what was the first thing his protagonist did? Saddled the poor little bastards with the author's own religion! Gifted them with shame and sin and an angry but bribable paternalistic God and a lot of other 'moral' mumbo jumbo. Phooey. He had greatness in his hands and he blew it. That time."

I didn't quite agree, but the differences were quibbles. And I had something else to think about. This wasn't

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a science fiction story Daniel was describing, or any cockamamie "thought experiment". . . .

I once heard a black woman use some memorable language: she described someone as having been "as ugly as Death backin' out of a outhouse, readin' *Mad* magazine; ugly enough to make a freight train take a dirt road."

All at once a thought uglier than that was slithering around under my hair.

"Talk about cynical," I went on, "why don't we get down to the crucial problem with this little thought experiment, as you call it?"

I was looking him in the eye, and he did not look away. But he didn't answer me either. So I did.

"The problem is, where do you get the infants?"

"Yes," he said slowly, "that was the problem."

I poured more Irish coffee, omitting coffee, cream and sugar. When it was gone I said, "So you're the guy that laid the bad rap on all those gypsies." I was trying hard not to hate him. I try not to hate anybody, no matter how much it seems indicated, until I've walked around it a little while. And he hadn't said he was through talking yet. But so far I really hated this. . . .

He looked confused for the first time since I'd met him; then he got the reference. "No, no. That wasn't me, any more than it was gypsies. As far as I know, all that child-stealing gossip was sheer wishful thinking on the part of parents, combined with a natural hatred of anyone who didn't have to stay in the village they were born in. I've never stolen a baby, anywhere in Time."

"Then where did you get them? Roll your own? In a test-tube or a Petri dish or whatever? Were the donors informed volunteers?" Even if the answer was yes, I didn't like this one any better. Call up human beings out of nothingness, to be born (or decanted or whatever) and suffer and die, for purely scientific reasons? At least the first generation of them compelled to grow up without parents or role models, forced to reinvent love and law and humor and a trillion other things I took for granted? If they could? Grow babies as guinea pigs?

"I've never made a baby either," he said. "Not even with someone else's genes."

I frowned. "Den ah give up, Mr. Bones—how *did* dat time-traveler . . . oh." Then I said: "Oh!" And finally: *"Oh!"*

"A lot of infants have been abandoned on a lot of windy hillsides or left in dumpsters since time began," he said sadly. "If Pharaoh's daughter had happened to miss Moses, she probably could have picked up another one the next day. It tends to happen most in places and times where, even if the child had somehow miraculously been found and taken in by some contemporary, it would have had a maximum life expectancy of about thirty years. So I denied some of them the comfort of a nice quick death by exposure or predator, brought them to a safe place and gave them to means to live in good health for hundreds of years."

"And used them as guinea pigs," I

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said, but without any real heat in it. I was beginning to see his logic.

He didn't duck it. "That's right. Now you tell me: are my actions forgivable?"

"Give me a minute," I said, and poured more whiskey and thought.

Thou shalt not use human beings as guinea pigs.

Don't be silly, Spider. Accept that and you've just tossed out most of medicine. Certainly all the vaccines. *First* you use guinea pigs, sure . . . but sooner or later you have to try it on a human or you're just a veterinarian. And meanwhile people are *dying*, in pain.

Thou shalt not experiment on human beings without their informed consent.

Many valuable psych experiments collapse with informed consent. You can't experiment with the brain chemistry of a schizophrenic without endangering his life. You can't find out whether slapping an hysteric will calm him down by asking him: you have to try it and see what happens. Daniel's too is an experiment which by definition may not have informed consent: informing the subject destroys the experiment. Is there, Written anywhere, some fundamental law forbidding a man to withhold information, even if he believes it to be potentially harmful?

Thou shalt not use infants as guinea pigs.

Hogwash, for the same reasons as number one above. How do you test an infant-mortality preventative, if not on an infant? Should we not have learned how to do fetal heart surgery? Do not the benefits of amniocentesis outweigh the (please God) few who will inevitably be accidentally skewered? Would Daniel's orphans really be better off dead than in Eden?

Thou shalt not play God.

God knows someone has to. Especially if the future is as grim as Daniel says. And She hasn't been answering Her phone lately. When it comes down to the crunch, humans have always tried to play God, if they thought they could pull it off. . . .

Ah, there was the crux.

"And what kind of results have you gotten?" I asked.

His face split in a broad grin. "Ah, there's the crux, isn't it? If you examine the data that came out of the Nazi death camps, and profit from that terrible knowledge . . . are you any better than Dr. Mengele?"

I winced.

"That is the question I want you to answer," he said. "You are completely insulated from any possible backlash to your answer—the people who will ultimately judge me will never know you were consulted, even after the fact. There is no stick to be applied to you as a result of your answer. And now I will offer the carrot. The same carrot that got me into this."

I was already reaching for the whiskey. *Dammit,* I thought, *this isn't fair. All I ever tried to do was entertain people. . . . Balls,* came the answer from deep inside.

"If you tell me that constructing the experiment was a moral act," he went on inexorably, "I will tell you everything I can about the results."

Well, what would you have done? ■

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THE ALTERNATE VIEW G. Harry Stine

NOTHING BUT THE TRUTH

I'm not a scientist (and definitely *not* a "rocket scientist") although my degree is in physics. I was converted into an engineer three years after receiving that degree. Many readers have addressed mail to me as "Dr. Stine." I thank them but must remind them that I cannot claim that honorific. I'd prefer that it be "Ing. Stine," but I can't claim that either because I don't have a European engineering degree. Yes, I was interested in asking questions about the Universe and learning new things about it as scientific endeavor is supposed to do. However, I was and am an experimentalist. Not only do I want to make things that use the Universe but I also wish to have what I ask confirmed or denied by an answer from the Universe.

When I ask these questions of the Universe by attempted utilization or experimental inquiry, I always get an answer. It's always "the truth, the whole truth, and nothing but the truth." I may not understand the answer because I didn't ask the question I thought I did. But I always get a truthful answer from the Universe.

I wish I could get the same sort of results when I ask questions of "scientists" who are supposed to be searching for the answers.

I say "supposed to" because we seem to be in an era of "speculative science." Thus, the answer is likely to come back *not* as an answer from the Universe. Instead, it's (a) speculation or opinion disguised as data or (b) the truth and nothing but the truth, but not the whole truth.

I've pondered why this is so. At the risk of incurring the ire of some readers by promoting controversy—something I do for a reason I'll discuss later—I have to make a *guess* (i.e., voice an opinion based on observation but with no foundation other than speculation on my part . . . but remember that I'm labeling it as such at the start).

Both classes of scientist—the sort who gives me opinion-as-fact and the type who doesn't give me the whole truth—usually have turf to protect. The reason they do may rest upon the foundation for their tenured faculty positions or their ranking in the grant pecking order. This reason is scientific because it's psychological and sociological in nature. Another reason may be their political or philosophical ideologies. A third reason may be "scientific brahmanism" or "this is the

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Truth because I know more about it than you do."

I can understand and identify all three. However, many people cannot. They will accept as the unvarnished and unrefined truth any position protection, speculation, opinion, or partial truth they hear in a statement from a scientist. They've been told in school that "Science is Truth." Properly done, indeed it is. But they've never been told what "properly done" involves. They've never been introduced to the Scientific Method. So they believe anything labeled "scientific" to be true as a matter of faith. This is especially the case with news media types who are scientifically and technologically "challenged." It may not be true of ideologues who have an agenda to promote. Usually these latter people are neo-Luddites who hate technology or elitists who desire to control other people's lives.

I'm always highly skeptical of anyone—scientist, politician, religious leader, or anyone else—who claims to have The Truth. I hope that readers are, too.

Far too many people are blindly following those who claim to have The Truth.

I find this amazing in a period where a growing number of adults are of the generation that once loudly insisted, "*Question authority!*"

(I've been doing that all my professional life, but I do it by questioning the Universe as an engineer—and damned proud of being one. I don't know The Truth. I probably never will. I'm a pragmatist. The Truth is What Works, and I'm still learning What Works and what doesn't.)

All of this philosophical discussion is preamble to a situation that occurred on an on-line computer network. There I had the audacity to question some "scientific findings."

Because I don't want to muddy the discussion here with an issue having extremely high emotional and ideological content itself, I'm not going to reveal what it was about.

I could point to some simple experiments I made with inexpensive and available equipment. Anyone could do the same. I referenced data from the *Chemical Rubber Handbook of Chemistry and Physics* and accumulated data from over a century of observations in books that have been available to anyone in nearly any public library for years. This was in a field where both my father and I have maintained an amateur interest over a period of 70 years.

Was all this now suddenly *wrong?*

My questions were not answered. I was immediately attacked as not having read the current literature. I had the *audacity* to question The Truth!

My response was, "OK, what *is* the current literature? Point me to the articles in respected peer-reviewed journals, papers that not only report the data but show the data acquisition and reduction methods or the computer models that were used to draw the conclusions. Where is the data? The real data, not just semi-conclusions based on speculation?"

I was given two references. Having both a good public library and a university library available to me, I obtained and read them. They were papers reporting on work done by third parties,

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not work carried out by the authors of the papers but interpretations of the work of others. Neither one contained pointers to the basic papers containing the data obtained from experiments conducted in the real Universe.

Where is the data?

I was told to download some documentation from the Internet. When I did so, I saw it had not been peer-reviewed and had not been published elsewhere. It was full of speculation, admitted and otherwise. *Anyone* can upload *anything* on the Internet where no peer-review mechanism exists to check it. This document was an academician's personal evaluation of an issue *outside his own field of professional expertise, education, and knowledge* that, if really based on experimental data and observations, would have *severe* economic, health, and life-style impacts.

It may have contained the truth, but it may not have been nothing but the truth and may not have reported the whole truth. Most of the references were authors' names given in brackets in the body of the text.

Where is the data?

The whole matter struck me as another one of the "thought experiments" instigated by Albert Einstein and applied with growing utilization in many fields besides physics since then. Never mind whether or not the speculations checked out with the real Universe. They *ought* to be true! "We haven't found them yet. But give us another ten million dollars so we can continue to look. In the meantime, behave as if they're real and true because we believe they probably are."

Incidentally, although the speculative summary wasn't peer-reviewed, this no longer means what it used to. Nor is it a guarantee of a dispassionate review of the material. These days, people who can't get their papers published in peer-reviewed journals usually start their *own* journals with their own peer-review panels staffed with colleagues from their own Good Old Boy networks!

When I tried to continue the questioning, I was told by the advocates of this particular position that it wasn't their job to educate me, to answer my stupid questions, or to convince me. It was my job, they said, to read the literature and thus be convinced of its truth. If I wasn't, it meant that I had a closed mind and was unable to accept The Truth.

Is this the way to conduct scientific inquiry?

What happened to the Scientific Method that worked so well for so long?

What happened to Occam's Razor?

What happened to the KISS* Principle?

As readers well know, I'm not opposed to controversy but welcome it. This stems from my attendance at the first Astronautics Symposium sponsored by General Dynamics and the Air Force Office of Scientific Research in San Diego in February 1957 (before Sputnik for the historically challenged). At the conclusion of this pioneering conference, the organizers solicited a critique from Dr. Theodore von Kármán, pioneer fluid dynamicist and founder of both the Jet Propulsion

*Keep it simple, stupid!

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Laboratory and Aerojet Corporation. He rose to his feet and told us, "A very fine conference. Excellent papers delivered on pertinent matters in an interesting fashion by people who know their subjects. But *there was no controversy!* Ladies and gentlemen, how can we possibly make progress without controversy?" And he sat down.

Nearly 40 years later, we do indeed have controversy, but not the sort that von Karman meant. The controversy today has become ideologically based utilizing scientific speculation disguised as scientific inquiry. As in the advertising business (where I also have experience), it may indeed be a matter of telling the truth and nothing but the truth, but not the whole truth.

* * *

One can but hope that indeed the scientific truth, whatever it turns out to be, will win out eventually against politicians who respond to scientific speculation by enacting laws and bureaucrats who react by imposing new regulations . . . neither of which appear to have any basis whatsoever on data taken from the real Universe.

At least, that's my alternate view of the situation. Being true to my scientific education, I felt impelled to report it to you.

You can argue with, agree with, or attack me via e-mail by posting to gharry@bix.com or to this magazine whose electronic address is 71154.662@compuserve.com. ■

(Biolog continued from page 53)
tion and novels come from different wellsprings so the two forms do not compete when working on both.

Placing third in a second WOTF contest and appearing in anthology number nine two years ago, he quit the day job for full-time writing. This permitted writing more than in the previous five years. He continues to read voraciously, including texts on every area of knowledge.

Using Budrys and Hubbard techniques of idea cultivation, Pete has amassed a stack of ideas he mines for stories. In his first *Analog* appearance for May, 1992, he worked out the effect of virtual reality on a character forced to put her mother in a nursing home. Editor Stan Schmidt pointed out the original viewpoint was unbalanced. The rewrite delineated the conflict in not being able to afford a high-tech solution.

Both of Pete's parents were teachers. At age ten, with a small telescope he discovered Jupiter's moons and calculated their orbits. It was disappointing to find that someone from Italy had already done so.

Writing SF is more interesting to Pete than focusing on the world we already have. Today's SF daydreams shape a 20th-going-on-21st century mythology about how people will cope under future conditions. He notes that the future keeps arriving every day, and is almost always different from expected. His daydreams are thought experiments working out how possible futures will affect real people. ■

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Jean Lamb

GALLEY SLAVE

Positions of real power are not necessarily the obvious ones. . . .

Illustration by Alan M. Clark

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Dr. Marybeth Bonet swore softly to herself as she tried to get two different sets of computer codes disentangled from each other. If Lt. Thomas Dalkey hadn't been so handsome she would have killed him. He was navigator of the *Cormorant*, a heavily armed ship patrolling the edges of the Solar System against the enemy. He'd earned a number of medals for courage and heroism defending human space against the sudden invaders. Unfortunately, he had also had the brilliant idea of tying the autochef into the main computer so it could be programmed from the bridge in emergencies. Why didn't people read the manual?

She was used to this kind of thing. This wasn't the first time she'd had to fix these little problems, especially since she'd designed a lot of the food programs in the first place. Admittedly, Dalkey hadn't complained about the eternal diet of waffles the autochef now seemed to favor. He'd asked for help only when the roast beef and gravy sequence had showed up in the star charts. As a civilian expert, she was more used to hearing grumbling about the food.

Marybeth had three main options. One was to exercise her global search and destroy option and restore both computers to their original configuration through manual recovery procedures. Unfortunately, that wasn't possible in the middle of this mission, or she would never have been sent out here from Terra in the first place. The giant felines that called themselves the Kzinti were an ever-present threat. As she thought about them, she bit her lip with anger. The human race had finally learned how to live with itself until *they* came. They had disrupted everything in less than a generation. She glanced down at the knife she wore in its sheath on her thigh. Even that was a sign how far the Kzinti had driven the humans out of their new Garden of Eden. Anything she could do to make the aliens pay was worth it. Granted, humans now had decent gravity systems on ships since adapting stolen Kzinti ones—but it was a poor trade.

Her second option was to make Tom's plan work without disrupting either system. There wasn't enough time, though. She copied off his preliminary attempts, in case she could do something with them once she was back. The idea itself wasn't so bad, but the execution needed work. Marybeth proceeded as swiftly as she could on her third option, which was to delete any extraneous material from both systems. She had already designed an override sequence to allow the autochef to accept new menu items now, while Dalkey had nearly cleaned out the nav computer. Unfortunately, the override sequence was rather unwieldy. If there was enough memory left, she could boil it down into a macro or even install it to the normal add menu, then dump it once it was no longer needed.

Marybeth closed down, sighed, then stripped in the small changing room next to the even tinier shower. If she was going to get sweaty, she'd rather do it with Tom Dalkey, and not slaving over a hot autochef! All the

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crew members had shown interest in her when she'd transferred to the *Cormorant*. Being recognizably female helped, though she sometimes wondered if that was an absolute requirement on a ship starved for new faces. Still, as a pale office blob she rarely got such attention except on temporary duty jaunts, and she enjoyed it.

The only one she felt anything for, surprisingly enough, was Tom Dalkey, the handsome, dark-skinned navigator who'd caused the problem in the first place. It'd started as pure pheromones, but she wondered if it could be something more eventually. She'd liked the way he smiled at her when he ducked his head to get into the galley, and had learned to like everything else about him, too. She grinned to herself as she hung up the knife in its sheath by her clothes. She'd had to "accidentally" forget it three times before Tom got brave enough to proposition her.

Her smile faded. Another social change chalked up to the kzinti. Leaving the Golden Age had put a lot of women right back where they'd started. Warrior instinct expressed itself at home as well as out in space. A compromise made in the region once known as the Pacific Northwest was to allow only women to have knives sharp enough to cut durasteel—easily spotted by the blue-green tinge of the metal on their edges—as if the rattlesnake sheath wasn't enough. Fortunately the gossip shows adored focusing on the custom, while Detective Darla Dagger was the most popular character on *Cascade Cop*. It certainly saved time explaining things.

Marybeth snickered when she remembered the combination hygiene and knife-fighting class she and her friends had taken as young adolescents, known as "The Miracle of Life and How to Avoid It." The Alderson boy had been lucky to lose only two fingers when he'd picked on the class wimpette after her first lesson. All the girls had thrown Jenny Hooks a party, once she and the boy had gone through the inquiry process. Jenny could have lost her right to carry the knife for up to three years if she'd done it maliciously. Marybeth remembered hearing about a woman who'd lost it for life after killing someone in a robbery.

She gently patted the knife's hilt and draped her clothes over it. The one time she'd had to use it to defend herself, she'd thrown up afterwards. It still beat knowing she was at the mercy of anyone stronger than she was. Besides, the court had cleared her completely.

And it made wanting someone all that much more fun when she *knew* it was her idea!

She smiled to herself as she squeezed into the shower tube and turned on the water. If she positioned herself just right, the jets hit exactly where she meant them to. A pity these things weren't big enough for two! Marybeth fantasized what she and Tom were going to do when the computers were all tucked in their beds. The hot, soapy water rushed over her body. . . .

She heard an enormous bang. The shower's emergency seal whirred shut. Marybeth hit her head on a

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sprayer as a jolt sent her into the wall. Some of the water turned pink as it ran into the recycler. The small compartment tilted all the way to the side, then righted itself. Just as well it was so small since the walls helped support her. She felt sick and dizzy as the gravity wobbled.

The door opened. A furred, clawed nightmare glared at her. She shrieked and hysterically cowered in the little room. An enormous, tufted paw reached in. She attacked it with her teeth and fingernails as she felt herself being pulled out. She got in one good bite—mostly a mouthful of fur, then was flung towards the bulkhead. She barely covered her head with her arms before she hit.

Marybeth collapsed as soon as she slid to the floor. Something warm and wet trickled down her shoulders. Perhaps if she played dead . . . she lay down with her face against the bulkhead. She heard screams and blaster fire. She just lay there for a while. The noise moved away. She moved her head carefully and cautiously looked around. Nobody was there. She stood up slowly. The walls kept blurring in front of her. She felt better when she closed her eyes and felt her way along. The galley was close. She knew her way around it well.

Marybeth opened her eyes when she turned the corner. An enormous furry horror with a rat-like tail squatted on the floor and gnawed on something. Something red and white. A few cloth scraps were by its feet. They were blue. The kzin picked up a watch, sniffed it, and tossed it on the floor. It was gold, like the one Tom Dalkey was so proud of. He'd gotten it from his father when he'd graduated.

Part of her understood what had happened. She ducked into an empty storage locker and moaned softly to herself. Then she curled up into a ball and fled into unconsciousness.

Ship-Captain of the *Claw* conferred with his officers, as impatient as ever. Syet, the ship's telepath, still had a headache from helping the others track down stray humans on the captured ship. Mental contact with ordinary humans was bad enough, but the human-*rett* in heat had been disgusting. He'd heard rumors that the alien females were always that way, but hadn't believed them till now. No wonder their enemies were outbreeding the Hero's Race.

Of course, the others of his own kind despised him no matter how he suffered in order to help them. Part of it was jealousy. Telepaths were allowed more access to fertile females compared to ordinary kzinti, in hopes they'd sire more who would survive the mind-killing drug that created mental abilities. Fewer demands and more allowances were made in training.

It was only right, though, that even without prowess in combat he was allowed to think of himself with a name rather than just a title. That was necessary when several minds met. He was rather proud of his. *Syet* was the position of a cocked ear of a hunter listening for his prey, and there was no one better at that than he. Oh, he took full advantage of his position—he'd be a fool not to. In return,

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though, he pushed his abilities to the breaking point when needed. Few of his fellow telepaths bore the touch of alien minds as well as he did. Those he knew spent most of their waking time in the bottle or taking dream-dust.

Syet began listening to the conference with all his ears again. The captain was ranting as usual about their glorious conquest. As if twenty humans could stand up to a squad of the Hero's Race! Still, the *Cormorant* was a valuable prize. Much knowledge would be gathered about human capabilities once the ship was returned to be examined. The captain might get half a Name once he returned. *That was sufficient reason to be* proud.

The captain then ordered Argton-Weaponsmaster to command the prize crew to return the captured vessel to the main fleet. Ship-captain also ordered Syet to go along, ostensibly to take what remaining mental impressions he could from the ship. The real reason was much simpler. The weaponsmaster was ambitious and from a noble line, and might take the ship on a foolish suicide mission. Syet knew he was supposed to prevent it somehow. He could have told the captain it was hopeless. Argton despised all telepaths, and any suggestion from one was as good as a command to do the opposite. Unfortunately, that didn't remove the responsibility. The weaponsmaster was unpleasant, even compared to most of his highly-placed kinsmen. He didn't blame the captain for wanting to get rid of him for a short time. In a serious emergency, the telepath could make contact with one of his mind-fellows on a picket ship just outside the human Solar System. It'd cost him a day's blinding headache—or his life, if Argton caught on. Yet his duty to the Hero's Race was more important.

Ship-Captain added, "Keep an eye on the *rett* Argton-Weaponsmaster found. She might be useful."

Syet thought it was a mistake leaving her alive, but said nothing. He was supposed to advise the captain, even when it was unwelcome, but he was no fool, either.

The captain narrowed his eyes as if he knew what Syet thought anyway. "You yourself told me what impressions you got from her," he said. "She's certainly not a threat. Prize vessel duty is usually dull. The crew should be amused by her, and she might be trainable enough for some of the easier maintenance duties. If we get her to the main fleet alive, we could use her to get some of the prisoners to cooperate. If it doesn't work out, her meat should be tender enough, but you'd better have good reasons before you or anyone else disposes of her."

The telepath sighed. "Yes, Captain," he said. It had been a long time since he'd been allowed any live meat. Only those who'd actually fought had feasted this time. Still, it would be nice to have someone lower in status than him around for a change.

Marybeth gradually awoke. Her head pounded, her bladder was full, and every joint was cramped from being in the storage locker. She peered

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out the tiny vents. No one was there. She silently crawled out, though it hurt even more to move. She almost fled back in when she heard growls and curses from the galley. Then she slid forward a bit to see what was going on. She couldn't hide forever on a ship this size anyway.

She crept into the galley from the back way she normally used, and ignored the mess on the floor. One of the aliens was hitting the panel, obviously frustrated. Maybe this was a chance to make herself useful. She had no illusions about striking back. Right now she just wanted to survive.

Everything went gray for a moment, then cleared. *A slight concussion?* she wondered. She'd better use what brains she had left now, before she ended up as dinner. Marybeth tiptoed forward, carefully bowed in a submissive position. The kzin growled at her. His nose wrinkled. Marybeth cringed back while pointing at the panel. "This my job!" she said, over and over. Would the alien understand her? The giant feline swept out a paw, though with claws pulled back, and pushed her at the panel. She tasted blood as her mouth struck the edge, and squealed. Let them think her as frail as possible! Without another word she picked up the odd-looking disk on the counter and put it in the reader. Amazing that it fit, or that the reader got anything out of it at all. Either both types of computer systems showed convergent development, or everybody was borrowing from everybody as the war went on.

The notation system was completely alien, even after the computer did its best. There was no way she was going to be able to replicate this. She took out the disk, then selected what she thought they wanted. She was rather proud of her Kobe beef analog. She already knew they liked their meat raw.

The galley synthesis machinery powered up. The alien growled again. Marybeth made pleading gestures, and showed her bare throat. The orange, fluffy fur on the alien settled back down. Soon the first meat began coming through the output slot. The automatic cutter refused to work, though. A dent showed where the alien had struck it, too. Marybeth wearily set the indicator to manual, pulled out the blade by its handle, and began slicing the meat into large chunks as it came down the processing counter near the serving area.

She almost threw up at the sight and smell of the red beef streaked with white fat. It reminded her of Dalkey—or what was left of him on the floor behind her. She barely controlled the impulse to slice up the alien, though she knew the penalty for any threatening move.

The alien sniffed one large chunk, then inhaled it. He purred, obviously pleased with the result. He lightly patted her. At least he probably meant it to be light, though he left bruises. He went off while Marybeth was still at work, ducking carefully under the overhang over the back entrance. Pity he didn't smack his head on it. A dent in *that* would probably disable most of the electrical conduit for the engine room. She would have designed

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it so it was out of the way, but it probably made things easier for the maintenance people. At her height, she rarely noticed the thing.

She put chunks of meat on platters and set them on the two small tables outside the preparation area. The serving counter was hinged to be open or latched closed. Then she checked the drinks dispenser. All she got out of one was diesel-grade coffee, which she gratefully gulped down. She could retire if she learned how to synthesize something decent. She looked back into the galley, and shook with anger. There had to be a way to do *something*. Marybeth filled up another platter with meat, and cautiously left her sanctuary. It was a long shot, but worth checking out.

Unfortunately, the weapons lockers were already guarded. She should have expected it. Better to find out now, though, than depend on anything later. Marybeth approached the guards with the meat, bowed, set it down a fair distance from them, then fled. Her terror was not an act.

She made a quick run for the sanitary facilities. She shuddered when she looked at the shower cubicle, and washed herself in the sink. Her clothes were in a pile on the floor. She reached for them, then hesitated. As uncomfortable as it was, she'd be safer naked. Despite feminist pride, it was better to stay alive. If that meant letting them think she was little more than a beast, she'd just have to put up with it. It might make the aliens feel superior. Those who did so often made useful mistakes. Being a visible threat meant getting eaten. She was glad she'd had her shots, though. She couldn't begin to imagine the fun she'd have coping with a period in this situation.

She bundled the clothes up to throw them into the disposal to remove temptation. The sheathed knife fell on the floor. Marybeth dropped the clothes and clutched it to her. Then she paused. What good would it do her? She still couldn't bring herself to get rid of it. She had to get it to the galley somehow. She watched the hall for traffic, then spotted a couple of blankets in a doorless storage locker. Marybeth oozed over to it and put the knife in with the blankets. Then she took the whole bundle to the galley. Maybe she could establish the place as her territory. Even a beast deserved some kind of bedding.

She nearly panicked when she saw other aliens near the galley devouring the meat. There was a difference between pretending to be a coward and actually being one, though. Instead of vomiting on the floor, her first choice, she gulped and hastened back behind the counter. She put the blankets on a corner counter and began cleaning things up. Every stain, every bone fragment reminded her of Dalkey and how he'd died. She knew the rest of the crew was dead, too. Perhaps with the floor clean she might be able to sleep.

As she scrubbed, she ignored the slobbering noises outside. When she found Dalkey's gold watch underneath the bottom edge of a cupboard, she put it up to her face and cried a little. Then she went back to work. With her head out of sight, she

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opened each cupboard and made inventory. You never knew what could be useful. Her eyes ran over the usual cleaning supplies. If the aliens had a keen sense of smell, they wouldn't like the detergent. She'd better keep that tightly capped. The big jug might make a good club, though. She hefted it experimentally, then put it back. It would probably work better if she just threw it. Marybeth paid more attention to the broom. A knife attached to it with a length of cord would make a pretty decent spear. But she wouldn't be able to fix it up ahead of time without risking one of the aliens seeing it. She searched the closet for a tube of Sticktite but didn't find one. She could leave a sticky strip on the broom that would stay that way until she placed something on it—a knife's handle, for instance. Sticktite would hold almost anything forever till the proper solvent was applied. There had to be some on this ship, but it certainly wasn't anywhere in this galley. A pity she didn't have access to her own lab kitchen at home. Some of the attachments to her food processor could be seriously dangerous in the right hands.

She found knives in one of the drawers. Marybeth crawled over to her blankets, slid the sheathed knife across the floor, and put it into the drawer unsheathed like the rest. There the blade looked little different from the rest. She'd have to dispose of the sheath. For now, she stuffed it in a junk drawer just below.

The noises outside the galley stopped. Marybeth peeked out. The kzinti were all looking at another one that just came in. She couldn't believe this one was the captain! This alien was skinny, scraggly, and more like a half-drowned rat. One of the others made sniffling sounds, only to have someone next to him stick a claw in his arm. It was almost like they wanted to laugh at him, but were too frightened.

Then she felt a funny tickle in her head. The kzinti had telepaths, too, just like humans. She began humming a popular commercial jingle just under her breath. That might annoy him. Then she picked up Dalkey's watch. That drove anything else out of her head. *Red blood, white bones, the gold watch on the floor. . . .* The scruffy kzin shook his head, as if someone had splashed water on him. Yes. She had to watch out for him.

Syet held his head. It pounded in agony, but he had to eat. Then he could return to his room and silence the hideous voices inside his head with the bottles of whiskey he'd found in a small locker. He paused for a moment as the delightful aroma of proper meat filled his nostrils. Maybe the human-*rett* should live after all. He wished she'd shut up, though. Her mental singing was worse than Argton-Weaponsmaster's. Besides, he had absolutely no interest in what passed for thought in the little bitch. As long as she kept this food coming, he didn't care.

The Weaponsmaster summoned him as soon as he'd finished eating. Argton made up for his lack of height in utter ruthlessness. "A pity the captain doesn't see the opportunity now

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placed in our hands," the weaponsmaster began.

Syet knew the rest already, but listened politely. He had respect for his superior's claws, if not his brains.

"Though much of the navigational data for this system is in code," the weaponsmaster continued, "I'm certain our techs will be able to decipher it. We still have enough to avoid most of their defenses. I do not understand why the captain wants us to flee like cowards."

"I believe the captain has his reasons," Syet said. He hated seeing disaster come his way without being able to avoid it. He might as well agree with everything Argton-Weaponsmaster proposed, though, no matter how idiotic. It was safer that way.

"Possibly." The weaponsmaster flexed and unflexed his claws. "One who wished to keep all the honor to himself might also act this way. Too bad. There might be enough of it here for even someone like you to acquire a true Name. All *you* would have to do is keep quiet. Yet that might show enough courage to report your valor when we return in triumph."

The telepath could easily see himself being blown into floating debris instead. Syet was tempted, though. Telepaths had informal designations on their mental searches, but they were not true Names at all. "One wishes to know the extent of the plans," he said, "to advise and assist as is the duty of all the Hero's Race."

Argton closed his eyes briefly, a clear sign of approval which Syet got mentally as well. "As far as the techs can tell, we're on a course to rendezvous with another human ship in thirty of their days. If the human-*rett* is still alive, we can use her to lure them in. We should record her voice soon just in case. Once we have *two* ships. . . ."

Syet filled in the rest. One ship could return, as per the captain's orders, while the other rampaged through the human system—a rampage that might open the way to an outright invasion by the rest of the fleet. As long as ship captain got a human ship to examine, the telepath saw nothing wrong with the plan—just as long as he was on the ship that returned. "Glory," he whispered.

Marybeth fell into a mind-dulling routine in the next few days. She awoke, sneaked in and out of the refresher, cowered when one of the aliens came near, and hid in the galley. Her arms didn't hurt as much from cutting meat as they did at first. One "morning" she laid out more Kobe beef. That was still the aliens' favorite, though she occasionally varied it with fish. She gave most of the kzinti nicknames, though she'd learned a few of their words. Furball was the tech who'd first tried to use the autochef. She took care to cringe in fear whenever he cuffed her around, though he didn't hit very hard. It was worth it, though. One of the others had tried to claw her up for no reason, and Furball had cuffed *him*. After that she made sure Furball got the first serving each meal time. He'd earned it. She gave names to others, too. Snaggletooth was the telepath, or

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so Marybeth thought. She kept Dalkey's watch close to her when he was around. He didn't spend much time in the galley, though. The only one she was really afraid of was a magnificently tiger-striped kzinti with a gloriously fluffy coat. Evidently both humans and kzinti made up for lack of height with attitude sometimes. Everyone else was scared of him, too. She nicknamed him Hobbes—nasty, brutish and short. She disappeared into her nest of blankets whenever he showed up.

One night she began to analyze the kzinti rations while preparing a meal for herself. Since she had become a sudden convert to a vegetarian lifestyle, she thought it was unlikely she'd be interrupted. It was like waking from a terrible dream to start using her mind again. It took several hours to crack their notation system. Fortunately, their style of structural charting was similar to human standard. Once she'd spotted a familiar-looking lipid she was home free. Once she and the computer knew where the carbons were, the rest was easy interpolation. No wonder the kzinti enjoyed beef and fish—as well as fresh human. Their metabolism was like that of Earth carnivores. The autochef food was clearly superior to the kzinti rations, as far as she could tell from the small amount she synthesized. The stuff was probably well-balanced and so forth, but it was clearly mulch, ready to eject in texture and flavor. The aliens' nutritional experts probably had the same slogan as at home: "Food will win the war—but how can we get the enemy to eat it?"

She concentrated on fat ratios. Lipid metabolism was a great deal simpler than protein, and seemed to work the same way for the aliens as it did for humans, judging by the rations. She wasn't surprised to find most of the fats were polyunsaturated. Kzinti probably got less exercise in space than they did on the ground. That was the standard for human food synthesis as well. She examined the carbons in the kzinti ration fats again. There was something odd about their number, but she couldn't figure it out. Marybeth hastily ate her soysteak and fake broccoli. Since the kzinti were using up the protein and fat reservoirs, she had free run of the carbohydrates. And after seeing Dalkey's remains she couldn't eat meat. It might even make her smell less threatening.

Was there anything she could do to the kzinti food? With their metabolism so close to human, anything overt would be stopped by the autochef's poison control program. Furball watched her too closely when she chopped the meat for her to add anything then. He also inspected the salt shakers. Could she reverse-engineer the kzinti rations and find something that'd be bad for them without getting the autochef to lock down?

There were a few things she could do now. Marybeth changed all the fats to saturated ones. That called up a nutrition flag, but went through. Then she increased the sodium to just under the max allowable. Just for fun, she converted one of the drink dispensers to grain alcohol. If that didn't increase their triglycerides, she'd like

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to know what would! A pity they were also hooked into the poison program, but such was life.

She poured herself a drink to celebrate still being alive so far, though it was only a combination of alcohol and a hideous orange drink substitute. She retired to her blankets with it, head blurry as she tried to piece together the molecular structure for a banana daiquiri in her head. When she was done with it, even the cold metal of Dalkey's watch brought back only good memories. His kindness, his sense of humor . . . the warmth of his touch whenever their fingers met during repair work. *Wonder what the rest of him would have felt like?* she thought fuzzily. The blankets were firm and warm, but not the way he would have been. She slid into sleep still wanting him.

Syet sat straight up in his bunk and nearly retched. He didn't know what to do. This was worse than the time three shipmates had killed each other in a mutual duel.

At first his head had been full of black and white thoughts. Maybe the techs were wrong, and there was an AI aboard. He didn't care as long as nobody made him try to read it. Then he'd gotten really confused when the thoughts blurred into whirling, skeletal shapes, and then into the brain of that damned *rett*. He shuddered at the impact of her lustful impulses. How those flabby, hairless humans found each other attractive was beyond him. Where did those other thoughts come from? The *rett*'s impressions had been so clear. Was she really imagining her partner?

Maybe she wasn't. Maybe there was a reason he'd gotten those computer-like thoughts at first.

One of the human crew was still alive! Most likely the *rett* had believed everyone was dead at first. Her grief still burned his soul. What if one of the others had survived in hiding, though? Of course the *rett* would help him—and naturally the little bitch would demand her reward. The human was undoubtedly plotting mischief.

Syet dug deep for courage and woke Argton-Weaponsmaster. The commander was angry at first, then concerned. A human on the loose was dangerous, and might keep them from fulfilling their mission. They both went down to the galley. Syet ducked beneath the low ceiling, while his superior barely had to nod. The *rett* emerged from her blankets with a squeal. Argton tore them away, in case she was hiding someone in them. They found only a glittering bracelet. The commander broke it in his rage. The *rett* began crying and gathered up the shining links. Syet didn't get anything besides terror from her. He couldn't find anybody with that wall of emotion she was projecting. Both kzinti tore open the storage bins and lockers in the galley. They found nothing worthy of report. The commander clawed the *rett* in annoyance, and she collapsed in a corner. Syet was embarrassed. He knew something was going on, but he'd never find out this way.

Weaponsmaster clawed him, too. "You'd better stop drinking so much! Or find yourself a different brand of

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dreamdust!" he shouted. "I'll have the ship searched again, just in case. If they don't find anything I'll make you pay for this!" he shouted as he stormed out of the galley.

Svet considered reminding the weaponsmaster that they were still in range of one of his friends. He decided it would push his superior too far.

There was more than one way to earn a Name. The next time he felt those thought patterns, he'd deal with it himself. A human pelt would convince anybody he was right!

Marybeth limped to the autodoc, whined and cringed till the kzin on guard let her use it, then slinked back to her lair. With luck she'd convinced Hobbes she wasn't a menace. Snaggletooth might still be a problem, if she'd interpreted him correctly. Simply staying under cover wasn't going to keep her safe. She could die at any moment from an alien's whim.

She thought longingly of her fighting-knife. The odds were slim that she'd take out even one of the aliens, let alone more of them. She wanted them all dead. Marybeth had no idea what course they were on. For all she knew they were headed out of the Solar System entirely. Suddenly she didn't care.

How much time did she have? When the ship had been captured, they were about a month away from rendezvous with the *Peregrine*. She wasn't sure how long it'd been since then. She had to assume they were still on course. If they weren't, it didn't matter as much. She might as well plan for a worst-case scenario.

She needed more information. She couldn't sleep now. A grate that led into the air vent system yielded to a mixing spoon handle used as a pry bar. Marybeth quietly made her way through it. One part led to a grate near the weapons locker. It was still guarded, of course, though probably to keep the aliens from killing each other, judging by what she'd seen earlier. She backed away hastily when one of the sentries wrinkled his nose in disgust. Well, she didn't like their smell either. She returned to the galley and rested. What was she going to do?

A few days later she cleaned up the spatters from a minor duel—no one died—between two of the kzinti. She took the soaked rag back to the galley and analyzed the blood. She wasn't sure what was normal, but spotted a high ratio of triglycerides in the blood fats. There was a difference between the aliens and humans, though. There appeared to be more carbons—about one-third more. The computer wasn't sure where they went. Of course it wasn't. It was programmed to follow human metabolism as its default template. She went back into the system menu and reset it. The carbons resolved themselves into glorious triples, as did the fats in the kzinti rations.

Of course. Coenzyme A in humans made use of fats by cutting off two carbons at a time. The kzinti equivalent plainly used three. If she could design a receptor molecule to gather up the triglycerides in the kzinti bloodstreams into clumps that

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blocked circulation in vital areas, she might be able to get it past the autochef poison control program.

Just as she finished figuring that out, it was time to serve the first meal. Hobbes came into the galley and swaggered over to the drinks dispenser. Well, it had certainly taken him long enough to figure it out why all his crew used the one in the corner. Even Snaggletooth had used it to fill his bottle.

Then Hobbes ripped it out of the wall and howled with rage. A stream of pure grain alcohol flowed onto the floor. She thought Furball was going to cry. Marybeth threw up her hands and looked as bewildered as she could manage, then shut off the outlet valve. The aliens stared at her as she mopped up the mess. Wonder what they'd offer for the first squeezing? Hobbes threatened her with his claws again. She kept from screaming at him only by imagining him as a rug. He'd make a pretty one, since his coat was longer and glossier than ever. She took care to limp on the leg he'd clawed before. Maybe he'd lose face by attacking someone so much weaker.

It worked. He turned from her and ripped a pawful of fluff from Furball instead. The poor fellow cringed nearly as hard as she did—though his eyes told another story. She wasn't the only one acting a role for self-preservation. And maybe she wasn't the only one who'd like Hobbes better as a floor throw. But it'd be stupid to count on any of the aliens as allies.

The next days and nights passed quickly. While fixing her own meals she spent all the time on molecule design. Whenever Snaggletooth came in, she gave him a full bottle as well as a platter of meat. Furball got the credit, but she didn't care. Other bottles were also handed over, but only to aliens she and Furball approved of. Her head whirled sometimes with lack of sleep, but it didn't matter. If she failed, she'd get all the rest she needed anyway. Fortunately, she could do some of the design work mentally. Marybeth had always had an internal 3-D screen, which had come in handy at school when the computer was down or unavailable. Snaggletooth looked at her oddly sometimes, but never caught her at the computer. She was getting rather tired of synthesized broccoli, but that vegetable seemed to be the most effective in keeping the kzinti away.

One "evening" she thought she was bringing up the menu to work on the receptor molecule, and got the nav computer instead. *Oh, Tom,* she thought ruefully. *I thought we'd gotten all of that fixed by now.* It helped sometimes to speak to him mentally, even though he was dead.

If the screen was right, though, a ship was approaching and would get here in less than 24 hours. She'd wasted enough time tinkering with the stupid thing. It was time to take her chances with it. Having aliens control the *Cormorant* was bad enough. What could they do with two ships?

She finally bailed out and got the right program up. She ordered synthesis and input. *There, Tom. It's the best*

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I can do. Just wish it could be nastier she thought to herself.

A tufted paw lifted her out of the chair and into the wall. She slid down it, stunned. "Where is he?" Snaggletooth growled. Marybeth just let her jaw hang open. Then she leaped for the drawer. She had to get the knife.

Snaggletooth struck her again. "Where is he?" he repeated.

Oh shit. She landed near the cleaning supplies. Without hope she reached in and grabbed the detergent jug, stood, and threw it at him. He clawed it away from him. Cleaning fluid splashed on him as he inadvertently sliced it open. He gave out a thin howl and shook his claws to get the smell away from him.

Marybeth used that momentary distraction to go for the drawer with the knife. Without thinking, she leaped forward with the hilt in her hand and attacked Snaggletooth's claws before he could use them against her. She was astounded at how easily the knife cut through them. His blood spurted out on her. She whirled quickly and went for the other side as the kzin swung at her. The knife worked just as well the second time. She stabbed for the throat, but Snaggletooth swept at her with his arms and the blade went high. He howled as the point scraped by his eyes.

Suddenly she went flying as a blow from his clawless arm batted her away. Somehow she managed to hang onto the knife. Then Snaggletooth started coming at her again, and raised one hind leg to kick. He must be smelling her. Marybeth panicked. She couldn't see! Her eyes and hands hurt as if she'd been cut. Then she saw him approach nearer as her vision slowly returned. If she attacked again, he could easily switch legs and get her with the other one. She turned and fled out the back, and never noticed the overhang two inches above her head. Perhaps if she got to the air vent. . . .

Snaggletooth approached the galley. He couldn't believe it. The *rett* was actually talking in her mind, not just indulging in emotions better suited to a cub not yet weaned. This time he'd catch her with the male she'd been hiding all this time. He imagined himself presenting the pelt to Argton-Weaponsmaster, and being praised in front of the rest of the crew for his diligence in protecting the Hero's Race. He was startled to see the *rett* by herself again, but not very much. No doubt any human who'd lasted this long had good reflexes. Where was he this time?

Then he caught the true taste and smell of the *rett*'s mind. He hissed in astonishment. How stupid he'd been! Just because females of the Hero's Race were properly docile, he'd assumed those of the enemy were that way as well. The depth of her duplicity awed him. She'd even used his weakness for liquor against him.

It took only a moment to realize this and act. She planned something evil for the food they ate, he was sure of it. The crew and commander must be warned—but not until he'd destroyed the enemy and removed her menace forever. She might all too easily convince the rest that she was just

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a silly *rett,* while he was only imagining things. He had been drinking more than usual lately and he knew what the weaponsmaster thought.

He snarled and batted her against the wall. He might as well get some decent amusement out of it. Then she flung a jug at him, clearly desperate. He clawed it away, only to gasp in horror at the acrid stuff that came out of it. Once he was halfway free of it, the human faced him with a knife in her hand. He almost laughed. No puny blade was a match for the ones the Hero's Race were born with!

He roared in shock and horror as he watched his claws fall onto the floor. He instinctively struck with the other, only to lose them as well. The human came close enough to thrust at his face. He beat at her with his arms, only to feel the knife brush lightly at his face. Blood poured down and ruined his vision.

Syet had been in duels before. Not even telepaths could avoid them all the time. He jumped into Marybeth's mind as he assumed a fighting stance that allowed him use of his hind claws. He had learned long ago to watch himself without losing track of where he was. It was odd looking out of the alien's eyes and watching his own blood stream down onto the floor, but no odder than realizing her long, deadly plans to poison them all. He left just enough of himself in his body to make it hop towards the human. He had no idea he appeared so large and terrifying to the female. Then he squeezed her mind from the inside. As he hoped, she panicked and fled. One blow from a hind claw would rip her spine from her body. He had to act quickly, though, before she reached the vent system.

He was shocked back into his body as he ran into the overhang. Syet mewed with pain and astonishment. What a fool he'd been to forget how much smaller the alien was. As much as he hated to, he was going to call for help. The crew's safety was more important than his own humiliation. . . .

Marybeth turned around as her mind was suddenly free of the overpowering shadow of fear that had possessed her before. She hadn't been thinking. If she hid in the vents, Snaggletooth would be free to warn the rest of the kzinti about her. As a telepath, he might warn them about the food, too.

Snaggletooth just stood there in back of the overhang. Then he began to move away. She couldn't let him get away, even if it cost her life! At first she'd just wanted to live. Then she'd wanted revenge. Now she just wanted to kill. Even if she was caught, she had to silence the telepath before it was too late.

She swiftly ran back into the galley, her feet sticky with Snaggletooth's blood. For a moment, he turned towards her and began to open his mouth. Marybeth thrust the knife into the alien's throat and slid it as far in as possible. The blade scraped a little on the thick vertebrae in back and then kept going. Snaggletooth shuddered, then fell forward. She tried to get out of his way in time, but couldn't, though she did get her knees up. She was nearly suffocated by his weight,

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the same way she'd been the one other time she'd had to use this blade. . .

He wasn't moving. The smell of his blood nearly made her throw up, but at least it wasn't hers. In fact, it was still slick enough underneath for her to wiggle to one side. Fortunately her knees kept her from being totally crushed. She turned so she was on her side. Snaggletooth's body fell more, but the hilt of the knife caught on what was left of the telepath's neck and propped him up as she braced it on the floor. It only left her six inches to maneuver in, but it was certainly better than being pinned down forever.

She finally dragged herself out from under Snaggletooth and took a big breath of air. Her ribs hurt some, but that appeared to be all. *This was not a fun date,* she said solemnly to herself.

Then she heard the hum of lights that signaled change of shift. She didn't have much time till the others would start coming down for breakfast. If there was only some way she could get her knife out, but she didn't see how. She decided to bluff her way out. First she cleaned herself up. She had new bruises all over, but they blended in nicely with the ones she'd had before. After a moment's thought, she smeared some blood on the drawer that held all the kitchen knives.

As soon as Furball showed up for his serving she went hysterical. She wasn't acting. She mimed a big, nasty fight, showed him the dent in the overhang where Snaggletooth had hit his head, and tried to indicate that "the other one went thataway." When Furball tried to question her, she sketched out a height not that much higher than her own. She didn't think that kzinti could go pale, but Furball did his best as he apparently came to the conclusion she hoped he would. After all, Hobbes fit under the overhang. Furball picked up the body, but stared at the knife. Marybeth hastily pantomimed the drawer holding all the knives being pulled out and knocked onto the floor, then quickly huddled into one of her blankets to show that she was hiding during most of it anyway. She didn't have to force herself to start crying.

With any luck, Furball would be too frightened to ask Hobbes anything till it was too late. They cleaned most of the mess up. Marybeth washed and put the deadly knife back in the drawer once Furball got it out of Snaggletooth's body. Two other kzinti came down and carried the telepath's remains off. She began slicing up the morning ration. Furball kept watching her. He probably had his suspicions, but not as much as if he'd caught her taking the body apart herself. Then he took one platter and set it in front of her. She gagged down a few mouthfuls so as not to make him suspicious. Fortunately the beef was salty enough for her to stand it. Um . . . did humans have any processes that involved triple carbon bonds? She didn't think so, but hoped that her vegetarian diet would protect her from most of the receptor's effects. Making sure *they* ate it was more important. She just hoped the DMSO-type delivery molecule would get the enzyme through kzinti mucous membranes as well as her own.

After the meal, she finished clean-

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ing everything up. It would take hours for the molecule to take effect, if it ever did. She trembled as she picked up the platters. At least she could *think* what she wanted to about them now!

As soon as the place was clean, she went into the air ducts with her special knife. Perhaps she'd smell like a meat-eater from this morning. She was certainly sweating hard enough. Then she picked off a clump of fur from a screen in the vents and rubbed it all over herself. That might help. Marybeth listened for complaints. She was ecstatic when she heard gripes about headaches, chest pains, and numbness from the aliens. At least that was how she interpreted their gestures as she caught sight of them through the grates over the vent outlets.

Then someone roared in anger as a kzin fell to the floor. Given the anger in the voice she thought she'd just learned the kzinti word for *poison*. She heard lots of comments with *rett* this and *rett* that. A good thing she wasn't in the galley! They probably thought a dangerous human was running around. How right they were.

The next few hours were a nightmare of roaming from air duct to air duct as the kzinti scoured the ship for her. She thought the engine sounded odd, but figured that was because she was closer to it than usual. A good thing the kzinti were too big for the vents! Lethal or sleepy gas would disable them, too, unless they blocked off just one section. She kept moving to make that harder. Once she screamed out a vent, "I killed him! And now you're all going to die, too!" Then she laughed.

The ship rocked as something hit it. Of course! The *Peregrine* must have come, and the kzinti couldn't answer the challenge correctly. Then she heard the sizzle and clang of weapons as men from the other ship boarded. She peered out of a vent. A dead alien lay by a weapons locker without a mark on him. She kicked the grate out, grabbed a disrupter for herself, and slid back in the duct. She headed towards the loudest noise, then peered out again. Hobbes was fighting two marines, and was winning. Marybeth popped open the vent and blasted him right in the back. Two other kzinti were already on the floor, but she shot at them anyway, just for fun. Besides, they might be faking. The marines gaped at her. She waved at them, then crawled back into the duct to look for another fight. The ship's gravity cut loose again. She banged her head right on the old sore spot. She felt herself blacking out, but didn't care. She'd won.

Lt. Aziz helped the unconscious woman into the autodoc. At first he'd thought she was dead. After the mopping up was done, two marines had sworn they'd seen a naked female come out of an air vent and join the battle. Even though the commander had been skeptical, they'd gone looking anyway. Armed. The ducts were designed to fit humans, not the aliens, but one never knew.

Aziz had been very surprised to find her. The only woman assigned to the *Cormorant* had been a civilian specialist sent to fix the autochef. The

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skeletal figure who'd damned near bit off his ear when he'd tried to put her into the shower hardly resembled her picture at all. He sincerely regretted having to sedate her.

Dr. Bonet looked a little better once she'd been cared for. She'd have to undergo major surgery back on Earth for muscle repair and scar removal, as well as diagnostics for her head injury. How she'd managed to live so long as a prisoner of the kzinti was beyond him. Her internal status had stabilized once she'd received several pints of universal blood substitute.

The next day, she was able to sit up and ask for something to eat and drink. She laughed hysterically when he offered something from the autochef. He decided to humor her and fetch something from the other ship. For all he knew, the kzinti had gotten their rations programmed into it. He'd had a taste of them once, and didn't blame her if she'd gotten tired of them. Especially if a bad batch had been responsible for killing the kzinti they'd found dead without any wounds on them.

She stared at him as she huddled in her blankets. "I've contacted Earth," he said, trying to make her feel better. "I can offer you anything within reason, including the captain's best whiskey. You've gone through a terrible ordeal. Once you're back on Earth you can ask for anything, reasonable or not. They say the rehab program on Hawaii is very nice." He wondered if she'd ever make it out of it, or join the permanent residents. It was too soon to tell.

Dr. Bonet smiled at him, though he thought she put a little too much teeth into it. "All I want," she said, "is a decent cup of coffee, my clothes, a hot bath in a real bathtub. . . ."

Lt. Aziz nodded briskly. "No problem. We're heading towards a station with its own spin and a little more room. You can have the first two right off, though I recommend a slug of brandy to go with that coffee. Anything else?"

"Yes," she said with another smile. *Definitely too much teeth this time,* Aziz thought. She leaned forward and whispered, "A fur coat." ■

Editor's Note: This story uses the background of Larry Niven's "man/kzin wars" stories, with Mr. Niven's kind permission.

MOVING?

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Probability Zero

Guy Stewart

ABSOLUTE LIMITS

"MIT and ESA have virtually given up on it. What makes you think you can figure it out?" said Barney Sanchez.

Lila Duerkop turned into the fast lane. Snowflakes drifting from a winter sky shot past them.

A gold Toyota cut her off, its horn blaring. "You'd think since Congress changed the speed limit to eighty people would be satisfied. But noooo! Everybody has to drive a hundred now!"

It was a ritual complaint from their early days at the University of Minnesota. Barney said, "Maybe she was in a hurry?"

"Speed limit is a law. But Americans think it's a challenge to their in-

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alienable right to do whatever they please." She got into the fast lane as cars continued to race past them. "Back to your question: we can figure it out because we're creative. MIT and ESA have thrown money at it. But I believe the solution will come from finding a unique viewpoint. We've had the Buhari Equations for six years. We know FTL speeds are possible."

Once over the Mississippi, they parked in the open faculty ramp and got out. "We're going to break this law, Barney."

Nodding, he opened a stairwell door for her. "See you later, honey."

"Have a nice day at lawyer's school, dear," she replied, grinning.

They were on their way home late when an old Mustang rocketed past them.

"A jet engine!" Lila exclaimed as the orange ring of flame faded into the night. "He must have been doing two hundred."

"The cops couldn't catch him even if they wanted to." Barney settled back in the seat. "If Congress could see the way people drive, they'd change the law."

"If they did, no one could figure out a new way to make up the lost income." They both laughed. Lila gasped and the car swerved.

"What's wrong?"

"I've got it! A way to get the unique viewpoint we need! For free."

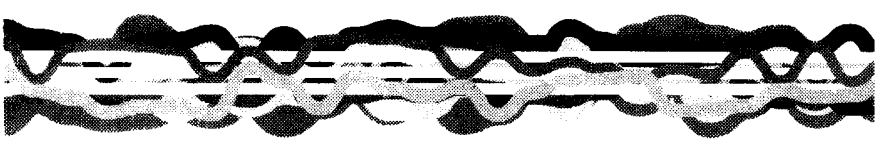
"What. . . ."

Turning to him with a wild grin, she said, "You've got connections. And now I have a plan. . . ."

When the federal law went into effect, the new signs earned Congress a Golden Fleece The Public Award. Committees and action groups were formed to fight it, but in the end, the law prevailed.

On their way home seventeen months later, Lila slowed the car to look. It was wider than the old signs had been and the numbers and the units had changed. But it was still familiar.

Blushing rouge from a spectacular May sunset, the black on white sign plainly read, "SPEED LIMIT 186,000 MPS."■



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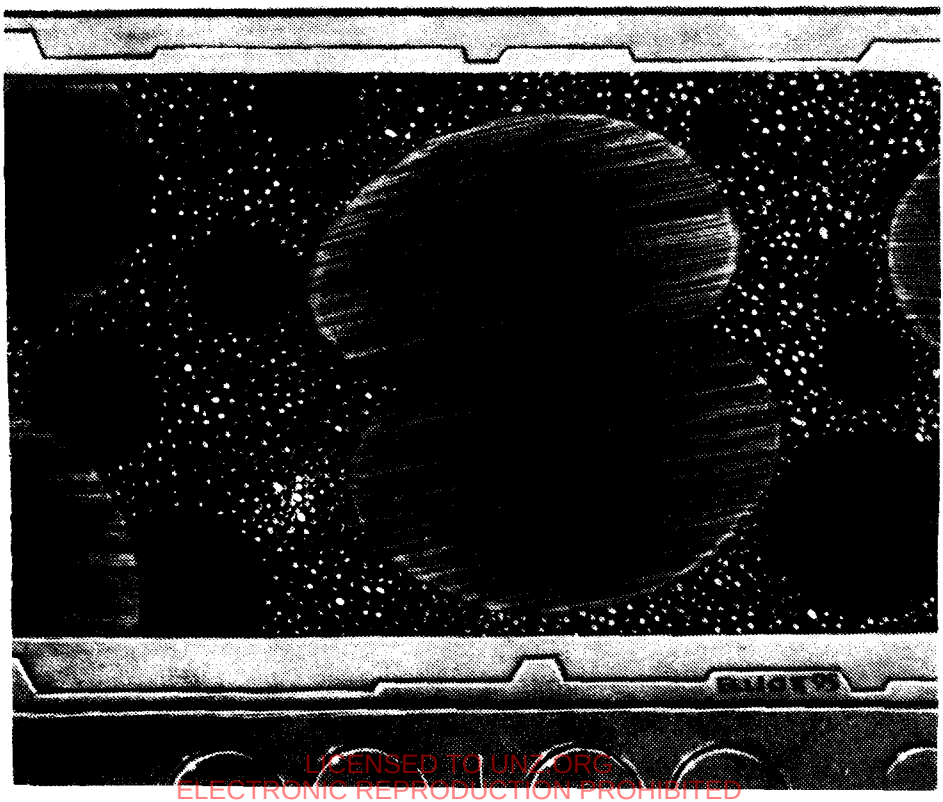
Part Two of Four

Robert J. Sawyer

STARPLEX

Communications may be possible across even the deepest and widest gulfs—but that leaves plenty of room for unanswered questions!

Illustration by Darryl Elliott



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Synopsis

The giant starship Starplex *is severely damaged, and hundreds of Commonwealth citizens are dead.* **Keith Lansing**, Starplex*'s director, is in a small travel pod, heading away from* Starplex. *He approaches a shortcut—one of four billion artificial and apparently abandoned stargates that permeate the Milky Way Galaxy—selecting the appropriate entrance angle to exit at New Beijing (the Earth colony world of Tau Ceti IV).*

But instead of emerging at his intended destination, Keith arrives near a rose-colored nebula. A starship from some vastly advanced culture, shaped roughly like a dragon, approaches Keith's pod and draws it into a cavernous docking bay. Keith had *correctly selected for Tau Ceti, but he's been diverted—by someone who can control the stargates. Keith realizes he's about to meet the never-before-seen makers of the shortcut network.*

The bay's interior is transformed into a simulation of Earth's countryside. A transparent humanoid figure, whom Keith dubs **Glass**, *appears. He says Keith holds the key not just to the future, but also the past. The humanoid is inordinately interested in Keith's family: his wife.* **Clarissa "Rissa" Cervantes**, *who serves as* Starplex*'s head of life sciences, and their son* **Saul**, *now off at university. But soon Glass is called away, and Keith is left to explore the Earth simulation. He notes that some of the details are wrong: all the clover is four-leafed, and although he recognizes many of the plant and animal species, he also sees an emerald songbird that's completely unfamiliar. Keith is left puzzling this over, while we learn the story of how he got to this point. . . .*

The year is 2094. Eighteen years earlier, the shortcut network was discovered. Shortly thereafter, humans and dolphins joined with two alien races to form the Commonwealth of Planets. The alien races are the Ibs (wheeled, gestalt creatures from the planet Flatland, 53,000 light-years from Earth) and the Waldahudin (six-limbed, piglike creatures from the planet Rebbollo, 70,000 light-years from Earth).

A shortcut is inactive until something enters it locally. When a new shortcut comes on-line, the giant Commonwealth research vessel Starplex *is dispatched to investigate. But when* Starplex *emerges at the most recently activated exit point, the crew is amazed to see* twinkling *stars in open space.*

Of course, it turns out that the stars aren't really twinkling. Rather, they're being obscured by clouds of dust and hundreds of giant Jupiter-sized spheres. The spheres seem packed much closer together than their gravity would normally allow.

Automated probes are sent into one of the spheres, and samples are brought on-board. The material is bizarre indeed: it has no electrical charge whatsoever, it can pass through regular matter, and, in addition to its long-range gravitational force, it also possesses a short-range

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repulsive force. **Jag**, *the Waldahud who serves as* Starplex*'s head of physical sciences, is the first to realize that the material is* dark matter. *Dark matter makes up the vast bulk of the mass of the Universe; its gravitational effects are detectable, but its actual nature has never been determined.*

Other research is going on simultaneously aboard Starplex. *Rissa and an Ib named* **Boxcar** *are undertaking experiments in life prolongation, although so far they've had no luck. Rissa confides to Boxcar that she's concerned that her husband Keith is contemplating an affair with another woman, possibly* **Lianne Karendaughter**, Starplex*'s internal-operations manager. Meanwhile, Keith finds himself fighting with Jag. Jag is one of five males competing for a specific female; he is determined to find glory enough to win her, no matter what.*

Suddenly the shortcut nearest Starplex *starts to open up. What appears to be a starship fusion exhaust is blasting through the aperture, as if a vessel had been braking when it entered the stargate. But the aperture keeps growing larger and larger, and the fusion exhaust is green. A tongue of plasma shoots out toward* Starplex. *As the shortcut continues to swell in size, Jag realizes that the object emerging from it isn't a spaceship—it's a star!*

Starplex *is bombarded with radiation from the star. Keith turns the ship so that its lower decks face the shortcut, and everyone is evacuated to above the central ocean deck; the water in it provides shielding from the radiation until the ship reaches a safe distance.*

Jag and a dolphin named **Longbottle** *do a flyby of the star in a heavily shielded probeship. Jag is perplexed by what he finds: a star with so much metal content simply should not exist in a Universe as young as ours.*

A communications buoy pops out of the shortcut with staggering news: stars have also emerged from the shortcuts nearest Tau Ceti and Rebbollo—and the phenomenon may be even more widespread than that. . . .

Part 2

CHAPTER 9

"I say we're under attack," announced Thorald Magnor, getting up from the helm position, and walking over to the seating gallery to sit a few chairs to the right of Jag. "We've apparently been lucky so far, but dropping a star into a system could destroy all life there."

Jag moved his lower two arms in a Waldahud gesture of negation. "Most shortcuts are in interstellar space," he said. "Even the one you call 'the Tau Ceti shortcut' is still 37 billion kilometers from that star, more than six times as far as Pluto is from Sol. I would say that in fifteen out of sixteen cases, the arrival of additional stars would have minor effects on the closest systems, and, since inhabited worlds are few and far between, the chances of actually doing short-term damage to a planet with life on it are quite small."

"But could these stars be, well,

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bombs?" asked Lianne. "You said that the green star is very unusual. Could it be about to explode?"

"My studies of it have only begun," said Jag, "but I would say that our new arrival has at least two billion years of life left. And singleton M-class dwarfs, like the one that popped out near Tau Ceti, don't go nova."

"Still," said Rissa, "couldn't they disturb the Oort clouds of star systems they pass close to, sending showers of comets in toward the inner planets? I remember an old theory that a brown dwarf dubbed—Nemesis, I think it was—might have passed close to Sol, causing an onslaught of comets at the end of the Cretaceous."

"Well, Nemesis turned out not to exist," said Jag, "but even if it did, today each of the Commonwealth races has the technology to deal with any reasonable number of cometary bodies—which, after all, would take decades or even centuries to fall into the inner part of a system. It is not an immediate concern."

"But why, then?" asked Thor. "Why are stars being moved around? And should we try to stop it?"

"Stop it?" Keith laughed. "How?"

"By destroying the shortcuts," said Thor, simply.

Keith blinked. "I'm not sure they can be destroyed," he said. "Jag?"

The Waldahud's fur danced pensively for a moment, and when he spoke, his bark was subdued. "Yes, theoretically, there is a way." He looked up, but neither of his eye-pairs met Keith's gaze. "When first contact with humans was not going well, our astrophysicists were charged with finding a way to close the Tau Ceti shortcut, if need be."

"That's outrageous!" said Lianne.

Jag looked at the human. "No, that is good government. One must prepare for contingencies."

"But to destroy our shortcut!" said Lianne, anger bringing unfamiliar lines to her face.

"We did not do it," said Jag.

"To contemplate it, though! If you didn't want us to have access to Rehbollo, you should have destroyed your own shortcut, not ours."

Keith turned around to look at the young woman. "Lianne," he said, softly. She faced him, and he mouthed the words "cool it" at her. He turned back to Jag. "Did you find a way to do it? To destroy a shortcut?"

Jag lifted his upper shoulders in assent. "Gaf Kandaro em-Weel, my sire, was head of the project. The shortcuts are hyperspatial constructs that extrude a nexus point into normal space. An absolute coordinate system exists in hyperspace. That's why Einsteinian speed restrictions don't apply there; it is not a relativistic medium. But normal space *is* relativistic, and the exit—the thing we call the shortcut portal—has to be anchored *relative* to something in normal space. If one could disorient the anchor point, so that it no longer could extrude through from hyperspace, the point should evaporate in a puff of Cerenkov radiation."

"And how would you disorient the anchor?" Keith asked, his tone betraying his skepticism.

"Well, the key is that the shortcut is indeed a point, until it swells up to ac-

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commodate something passing through it. A spherical array of artificial gravity generators assembled around the dormant shortcut could be designed to compensate for the local curvature of space-time. Even though most shortcuts are in interstellar space, they are still within the dent made by our Galaxy. But if you remove that dent, the anchor would have nothing to hold on to, and—*poof!*—it should disappear. Since the shortcut is so small when dormant, an array only a meter or two across should be able to do the trick, so long as it is fed enough power."

"Could *Starplex* provide the power required?" asked Rhombus.

"Easily."

"That's incredible," Keith said.

"It isn't, really," said Jag. "Gravity is the force that dents space-time; artificial gravity is all about modifying those dents. In my home system, we have used gravitation buoys in emergency situations to flatten space-time locally so that hyperdrives could be engaged while still close to our sun."

"How come none of this has ever appeared on the Commonwealth Astrophysics Network?" asked Lianne, her tone sharp.

"Umm, because no one ever asked us?" said Jag weakly.

"Why didn't you suggest we do that, then, to enable us to go to hyperdrive when the green star first appeared?" demanded Keith.

"You can't do it to yourself, it has to be done to you, by an external power source. Believe me, we've tried to develop ways for ships to do it on their own, but it doesn't work. To use the human metaphor, it would be like trying to pull yourself up by your own bootstraps. It can't be done."

"But if we were to do this right here and now—cause this shortcut to evaporate—we wouldn't be able to get back home," Keith said.

"True," said Jag. "But we could set up the antigrav buoys to converge on the shortcut after we had gone through it."

"But stars are apparently popping out of lots of shortcuts," said Rissa. "If we were to evaporate the Tau Ceti and Rehbollo and Flatland shortcuts, we'd be destroying the Commonwealth, cutting each of our worlds off from the other."

"To protect the individual worlds of the Commonwealth, yes," said Thor.

"Christ," said Keith. "Surely we don't want to end the Commonwealth."

"There is one other possibility," said Thor.

"Oh?"

"Transplant the Commonwealth races to adjacent star systems far distant from any shortcut. We could find three or four systems close together, with the right sorts of worlds, terraform them into habitable conditions, and move everyone there. We would still be able to have an interstellar community via normal hyperdrive."

Keith's eyes were wide. "You're talking about moving—what?—thirty *billion* individuals?"

"Give or take," said Thor.

"The Ibs will not leave Flatland," said Rhombus, with uncharacteristic bluntness.

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"This is crazy," Keith said. "We can't shut down the shortcuts."

"If our homeworlds are in jeopardy," said Thor, "we can—and we should."

"There's no proof that the arriving stars represent any threat," Keith said. "I can't believe that beings advanced enough to move stars around are malevolent."

"They may not be," said Thor, "any more than construction workers who destroy anthills are malevolent. We might simply be in their way."

There was nothing Keith could do about the arriving stars until more information was available, and so, at 1200 hours, he and Rissa went off to find something to eat.

There were eight restaurants aboard *Starplex*. The terminology was deliberate. Humans kept wanting to refer to *Starplex*'s components in naval terms: mess halls, sickbays, and quarters, instead of restaurants, hospitals, and apartments. But of the four Commonwealth species, only humans and Waldahudin had martial traditions, and the other two races were nervous enough about that without being reminded of it in casual conversation.

Each of the restaurants was unique, both in ambiance and fare. *Starplex*'s designers had taken great pains to make sure that shipboard life was not monotonous. Keith and Rissa decided to have lunch in *Kog Tahn*, the Waldahud restaurant on deck twenty-six. Through the restaurant's fake windows, holograms of Rehbollo's surface were visible: wide, flat flood plains of purple/gray mud, crisscrossed by rivers and streams. Clumps of *stargin* were scattered about—Rehbollo's counterpart of trees, looking like three-or four-meter-tall blue tumbleweeds. The moist mud didn't offer any firm purchase, but it was rich with dissolved minerals and decaying organic material. Each *starg* had thousands of tangled shoots that could serve either as roots, or, unfurling themselves, as photosynthesis organs, depending on whether they ended up on top or on the bottom. The giant plants blew across the plains, rotating end over end, or floated down the streams, until they found fertile mud. When they did so, they settled in, sinking until about a third of their height was embedded in the ooze.

The holographic sky was greenish-gray, and the star overhead was fat and red. Keith found the color scheme dreary, but there was no denying that the food here was excellent. Waldahudin were mainly vegetarians, and the plants they enjoyed were succulent and delicious. Keith found himself craving *starg* shoots three or four times a month.

Of course, all eight restaurants were open to every species, and that meant offering a range of meal items that met the various races' metabolic requirements. Keith ordered a grilled cheese sandwich and a couple of pickled gherkins to go with his *starg* salad. Waldahudin, whose females, like terrestrial mammals, secreted a nutritive liquid for their offspring, found it disgusting that humans drank the milk of other animals, but they

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pretended not to know what cheese was made of.

Rissa was sitting opposite Keith. Actually, the table was shaped in the Waldahud standard, like a human kidney, and made of a polished plant material that wasn't wood, but did have lovely bands of light and dark in it. Rissa was in the indentation in the table. The Waldahud custom was that a female always sat in this honored position; on their homeworld a dame would be positioned here, with her male entourage seated around the curving form.

Rissa's tastes were more adventurous than Keith's. She was eating *gaz torad*—"blood mussels," Waldahud bivalves that lived in the slurry layer at the bottom of many lakes. Keith found the bright purple-red color disgusting—as did most Waldahudin, for that matter, since it was a precise match for the hue of their own blood. But Rissa had mastered the trick of bringing the shell to her mouth, popping it open, and slurping out the morsel within, all without letting the soft mass be seen either by herself or anyone sitting across from her.

Keith and Rissa ate in silence, and Keith wondered if that was good or bad. They'd run out of idle chitchat ages ago. Oh, if there was something on either of their minds, they'd talk at length, but it seemed that they just enjoyed being in each other's company, even if they said barely a word. At least that's the way Keith felt, and he hoped Rissa shared that feeling.

Keith was using a ***katook*** (Waldahud cutlery, like duckbilled pliers) to bring some *starg* to his mouth when a comm panel popped up from the table's surface, showing the face of Hek, the Waldahud alien-communications specialist.

"Rissa," he barked in a voice somewhat more Brooklynish than Jag's; from the way the comm panel was angled, the Waldahud couldn't see Keith. "I have been analyzing the radio noise we've been detecting near the 21-centimeter band. You won't believe what I've found. Come to my office at once."

Keith put down his eating utensil, and looked across the table at his wife. "I'll join you," he said, and stood up to leave. As they made their way across the room, he realized it was the only thing he'd said to her during the entire meal.

Keith and Rissa got into an elevator. As always, a monitor on the cab's wall showed the current deck number and floor plan: twenty-six, and a cross shape with long arms. As they rode up, and the deck numbers counted down, the arms of the cross grew shorter and shorter. By the time they reached deck one, the arms had almost completely retracted. The two humans got out and entered the radio-astronomy listening room. Hek, a small Waldahud with a hide much redder in color than Jag's, was leaning against a desk. "Rissa, your presence is welcome"—the standard deference shown females. A tilt of the head: "Lansing." The rude indifference reserved for males, even if they were your boss.

"Hek," said Keith, nodding in greeting.

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The Waldahud looked at Rissa. "You know the radio noise we've been picking up?" His barking echoed in the tiny room.

Rissa nodded.

"Well, my initial analysis showed no repetition in it." He swiveled a pair of eyes to look at Keith. "When a signal is a deliberate beacon, it usually has a repeating pattern over a course of several minutes or hours. There's nothing like that at work here. Indeed, I've found no evidence of any overall pattern. But when I started analyzing the noise more minutely, patterns of one-second duration or less kept cropping up. So far, I've cataloged 6,017 sequences. Some have only been repeated once or twice, but others have been repeated many times. Over ten thousand times, for a few of them."

"My God," said Rissa.

"What?" said Keith.

She turned to him. "It means that there might be information in the noise—it might be radio communications."

Hek lifted his upper shoulders. "Exactly. Each of the patterns could be a separate word. Those that occur most frequently could be common terms, maybe the equivalent of pronouns or prepositions."

"And where are these transmissions coming from?" asked Keith.

"Somewhere in or just behind the dark-matter field," said Hek.

"And you're sure they're intelligent signals?" asked Keith, his heart pounding.

Hek's lower shoulders moved this time. "No, I'm not sure. For one thing, the transmissions are very weak. They wouldn't be discernible from background noise over any great distance. But if I'm right that they're words, then there *does* appear to be some discernible syntax. No word is ever doubled. Certain words only appear at the beginning or end of transmissions. Some words only appear after certain other words. The former are possibly adjectives and adverbs, and the latter the nouns or verbs they are modifying, or vice versa." Hek paused. "Of course, I haven't analyzed all the signals, although I am recording them for future study. It's a constant bombardment, on over two hundred frequencies that are very close to each other." He paused, letting this sink in. "I'd say there's a good possibility that there's a fleet of craft hiding inside or just past the dark-matter field."

Keith was about to speak again when Hek's desk intercom bleeped. "Keith, Lianne here."

"Open. Yes?"

"I think you'll want to come to the bridge. A watson has arrived with word that the boomerang has returned from shortcut Rehbollo 376A."

"On my way. Summon Jag, too, please. Close." He looked at Hek. "Good work. See if you can narrow down the source of the signals further. I'll have Thor take *Starplex* in a circular path around the dark-matter field, scanning for tachyon emissions, radiation, thruster glow, or any other signs of alien ships."

Keith strode onto the bridge, Rissa right behind him. They moved to their workstations. "Trigger watson

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playback," said Keith.

Lianne pushed a button, and a full-motion video message appeared in a framed-off section of the holographic bubble. The image was of a Waldahud male with a silvery-gray hide. Phantom replaced the sound of the creature's barking with English words for the playback into Keith's ear implant, although, of course, they didn't fit the movements of the Waldahud's mouth. "Greetings, *Starplex*." The status line at the bottom of the screen identified the speaker as Kayd Pelendo em-Hooth of the Rehbollo Center for Astrophysics. "The boomerang sent to the shortcut designated Rehbollo 376A has returned. I suspect you'll want to stay where you are, investigating the shortcut you're at now, since its appearance on the network is unexplained. However, we thought Jag and others would be interested in seeing the recordings made by the boomerang just before returning home. They are appended to this message. I think you will find them . . . interesting."

"OK, Rhombus," said Keith. "Use the data from the boomerang to create a spherical holo display around us. Show us what it saw."

"A pleasure to serve," said Rhombus. "Downloading now; the display will be ready in two minutes, forty seconds."

Lianne rubbed her hands together. "It never rains but it pours," she said, turning around and grinning at Keith. "Yet another new sector of space opened up for exploration!"

Keith nodded. "It never ceases to amaze me." He got up from his chair, and paced a little, waiting for the hologram to be prepared. "You know," he said absently, "my great-great-grandfather kept a diary. Just before he died, he wrote about all the great advances he'd seen in his lifetime: radio, the automobile, powered flight, spaceflight, lasers, computers, the discovery of DNA, and on and on." Lianne seemed rapt, although Keith was aware that he might be boring everyone else. To hell with them; rank hath its privileges, chief among them the right to ramble on. "When I read that as a teenager, I figured I'd have nothing to write about for my own descendents when my life came to a close. But then we invented hyperdrive and AI, and discovered the shortcut network, and extraterrestrial life, and learned to talk to dolphins, and I realized that—"

"Excuse me," said Rhombus, his lights flashing in the strobing pattern his species used to signal an interruption. "The hologram is ready."

"Proceed," Keith said.

The bridge darkened as the image of *Starplex*'s current surroundings was shut off, shrouding the room in featureless black. Then a new picture built up from left to right, scan line by scan line, washing over the bridge, until it seemed once again to be floating in space—the space of the newest sector to become accessible to the Commonwealth races.

Thor let out a long, low whistle.

Jag clicked his dental plates in disbelief.

Dominating the view, receding slowly, was another fiery green star, perhaps ten million kilometers from

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the shortcut point.

"I thought you said our green star was a freak," said Keith to Jag.

"That's the least of our worries," said Thor. He swung his feet off his console and turned to face Keith. "Our boomerang didn't activate that shortcut until it dived into it."

Keith looked at him blankly.

"And these pictures were taken *before* it did that."

Jag rose to his feet. "*Ka-darg!* That means—"

"It means," said Keith, suddenly getting it, too, "that stars can emerge from *dormant* shortcuts. Christ, they could be popping out of all four billion portals throughout the Milky Way!"

CHAPTER 10

That night, Keith was eating dinner alone. He loved to cook, but he also loved to have someone to cook for—and Rissa was working late this evening. She and Boxcar had finally had a breakthrough in their Hayflick-limit studies, or, at least, so it appeared. But they were having trouble replicating the results, and so she'd just had sandwiches sent up to her lab.

Keith sometimes wondered how he'd gotten the job as *Starplex*'s head honcho. Oh, it made sense, of course. A sociologist was assumed to be good both at managing the miniature society aboard the ship and at dealing with any new civilizations they might encounter.

But right now, despite all that was going on, there was little for him to do beyond the administrative. Jag would continue his dark-matter studies, as well as trying to make sense of the onslaught of stars; Hek would try to further decode the potentially alien radio signals; Rissa would pursue her life-prolongation project. And Keith? Keith kept hoping a windmill somewhere would start tilting at him—kept hoping for something important to do.

He'd decided to dine in one of the Ib restaurants. Not for the atmosphere, of course. With its almost billiard-ball smooth surface, Flatland's landscapes, as depicted in the restaurant's holographic windows, were even less visually interesting than Rehbollo's; there was no doubt that when it came to interesting geography, Earth was the most beautiful of the homeworlds. But Ibese food was based on right-handed amino acids; it was completely indigestible by the other three races. This restaurant, though, offered a wide range of human fare—including a chicken stir-fry, which was exactly what Keith had been craving.

The restaurant was inordinately crowded; the four eating establishments in the lower habitat modules were still uninhabitable. But one of the other privileges of rank was always getting a table without a wait. A sleek, silver robot showed Keith to a booth in the back. A large gestalt plant arched over it, orange octagonal leaves roaming its body freely.

Keith told the server what he wanted, and then he spoke to the desktop viewer, asking for the latest issue of *The New Yorker* to be displayed. The server returned with a glass of white

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wine, then rolled away. Keith was settling into the lead fiction piece in the magazine when—

Bleep. "Karendaughter to Lansing."

"Open. Yes, Lianne?"

"I've finished the engineering study on what to do about the irradiated lower decks. Can we get together so that I can give you my report?"

Keith swallowed once. Of course the report had to be dealt with right away: they needed to solve the overcrowding problem quickly. But where to meet Lianne? Gamma shift would be on the bridge now; no need to disturb them. Keith's office would be the natural place, but . . . but . . . did he really trust himself to be alone with her?

Christ, this is stupid. "I'm in the Drive-Through, having dinner. Can you bring the report here?"

"Sure thing. On my way. Close."

Keith had a sip of wine. Maybe this was a mistake. Maybe people would misconstrue, tell Rissa that he'd had a rendezvous in a booth with Lianne. Maybe—

Lianne came in, escorted to his table by a robot. She sat down opposite him and smiled. Geez, she'd arrived quickly—almost as if she'd known where he was before calling, almost as if she'd planned to catch him alone at dinner. . . .

Keith shook his head. *Get real*. "Hi, Lianne," he said. "You've got a report for me?"

"That's right." She was dressed in a cyan suit, crisp and professional. But on her head, crowing her lustrous platinum hair, she was wearing a smart replica of an old-style railway engineer's cap. Keith had seen her wearing it before, whimsical and stylish and sexy all at once. "There are techniques," she said, "for cleaning up radiation damage. But they're all time consuming, and—"

The server arrived, bringing Keith's dinner.

"Stir-fry," said Lianne, smiling. "I make a mean one of those. You should let me do it for you sometime."

Keith reached for his wine, thought better of it, picked up his napkin, and, in so doing, sent his fork tumbling onto the rubberized floor. He bent down to retrieve it—and saw Lianne's shapely legs beneath the table.

"Umm, thank you," he said, straightening back up. "That'd be nice." He indicated the steaming platter between them. "Did you—did you want some?"

"Oh, no," she said, patting her flat stomach, causing the fabric of her suit to pull tight across her breasts as she did so. "I'll have a salad later. I've got to watch my figure."

No need for that, thought Keith. I'll be glad to watch it for you. "About the radiation?" he said.

She nodded. "Right. Well, as I said, we can clean it up—but not quickly, and not without putting into drydock for several weeks."

"Weeks!" said Keith. "We can't afford that kind of time."

"Exactly. Which brings me to my suggested solution."

Keith waited for her to go on. "Which is?"

"*Starplex 2*."

Keith frowned. *Starplex* had been

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built at the Rehbollo orbital shipyards, and its sister ship—currently carrying the prosaic name of *Starplex 2*, although something else would likely end up being the official name—had been under construction now for close to a year. It was being built at Flatland; two such prime contracts couldn't go to the same homeworld, naturally. "What about her?"

"Well, she's not yet ready for launch, or I'd say simply commandeer the whole thing. But she's being built from identical blueprints to *Starplex 1*—and five of her eight habitat modules are already completed, according to the last report I received. We could pop through the shortcut to the Flatland shipyards, dump our lower four habitat modules there, and replace them with four of the completed ones for *Starplex 2*. The modules that we leave off could then be cleaned up at leisure. *Starplex 2*'s central disk won't be ready for another five months; the four hyperdrive generators have to be extensively tested before the engineering torus can be built around them. That should give plenty of time for the clean-up. When the time comes, our four old modules could be incorporated into the new ship. Of course, all the individual furnishings and equipment we had in our lower four will need to be cleaned up, too, but at least we'll have quarters and lab space for everyone right away."

Keith nodded, impressed. "That's brilliant. How long would that take?"

"The specs for habitat-module power-grid deconnection and reconnection call for three days, but I've devised an improved method that doesn't require powering down the couplings. I could do it in fifteen hours if we didn't need to wear radiation suits in the lower modules; in this case, eighteen hours should do the trick."

"Excellent. What about the lower part of our main shaft and our central disk?"

"Well, the shaft is three-quarters fixed up already. We can't clean it easily, but I've had nanotechs laying down extra shielding on its inner surface. As for the central disk, we'll have to completely replace the water in the ocean deck, of course. And not just with plain water, either. It has to be a full sea-water formulation, with dissolved salt and other minerals, plus, if possible, plankton and fish stocks. Also, I'd like to replace all the shipboard air, just to be on the safe side. The docking bays are no problem—they're heavily shielded. Same thing for the engineering torus; its shielding kept it from getting too much of a hit of radiation, as well."

Keith nodded. "How long till we can safely maneuver through the shortcut?"

"Tomorrow afternoon, maybe earlier. The gap between the shortcut and the green star is opening rapidly. And as long as you're willing to risk losing half a dozen watsons in trying, we should be able to get word of our intentions through to the Flatland shipyards right away so that the Ibs can start preparing for our arrival."

"Good work, Lianne." He looked at her, and she smiled again, a beautiful, warm, *intelligent* smile. Keith mentally kicked himself for sometimes for-

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getting that there *was* a reason she was aboard *Starplex*. Lianne Karendaughter was the best starship engineer in the business.

Thor piloted *Starplex* through the shortcut, and it popped out at the periphery of the Flatland system. From here, the Magellanic Clouds dominated the sky. Flatland's sun, Hotspot, was a white F-class star, and Flatland itself was a featureless ball, shrouded in white clouds.

Ibs were incapable of working in zero-g. Keith watched from a window as thousands of them swarmed around *Starplex* in hockey-puck-shaped solo travel units, transparent except for the opaque artificial-gravity plates that made up their bottoms. Since the work was being done by Ibs, not a second was being wasted. The new habitat modules were locked into place, giving *Starplex* all-new decks forty-one through seventy. Keith could just make out the bubble-shaped travel pod from which Lianne was orchestrating the entire operation. The only problem during the whole refit occurred when the hose draining off the ocean deck ruptured, and salt water sprayed into space, freezing into tiny ice particles that sparkled like diamonds in the white glare from Hotspot.

When it was all done, *Starplex*—now a hybrid of *Starplexes 1* and *2*—headed back through the shortcut.

Keith was delighted with the repairs—and even more delighted that everyone would no longer have to crowd into the upper half of the ship. Arguments had been breaking out amongst members of all the races. Perhaps now that they had plenty of room again, peace would once more reign aboard *Starplex*.

While at the Rehbollo shipyards, five new researchers were brought aboard—one Ib and two Waldahud dark-matter specialists, and a dolphin and a human who were experts in stellar evolution. All of them had dropped everything at receipt of *Starplex*'s reports, and immediately headed through the shortcut network to rendezvous with the ship at Flatland.

As she had promised, Lianne finished the refit in less than eighteen hours. Thor piloted the ship back through the shortcut, and they reemerged in the vicinity of the dark-matter field and the enigmatic green star.

CHAPTER 11

Starplex's designers had planned to put the director's office adjacent to the bridge, but Keith had insisted that be changed. The director, he felt, should be seen all over his ship, not just in one isolated area. He had ended up with a large square room, almost four meters on a side, located on deck fourteen, halfway along one of the triangular faces of habitat module two. Through the window that covered one wall, he could see module three, perpendicular to the one he was in, as well as a ninety-degree slice of the copper-colored circular roof of *Starplex*'s central disk sixteen floors below. That particular part of the roof was marked with *Starplex*'s name in wedge-shaped Waldahudar lettering.

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Keith sat behind a long rectangular desk, made of real mahogany. On it were framed holos of his wife Rissa, looking exotic in an old-fashioned Spanish dancing dress, and their son Saul, wearing a Harvard sweatshirt and sporting that strange goatee that was the current fashion among young men. Next to the holos was a 1:600-scale model of *Starplex*. Behind his desk was a credenza with globes of Earth, Rehbollo, and Flatland on it, as well as a traditional go board with playing pieces of polished white shell and slate. Above the credenza was a framed print of an Emily Carr painting, depicting a Haida totem pole in a forest on one of the Queen Charlotte Islands. Flanking the credenza on either side were large potted plants. A long couch, three polychairs, and a coffee table were also in the room.

Keith had his shoes off, and had swung his feet up on his desk. He never emulated Thor while on the bridge, but when alone he often adopted this posture. He was leaning back in his black chair, reading a report on the signals Hek had been detecting, when the door buzzer sounded.

"Jag Kandaro em-Pelsh is here," announced PHANTOM.

Keith sighed, sat up straight, and made a let-him-in motion with his hand. The door slid aside, and Jag walked in. After a moment, the Waldahud's nostrils started flaring, and Keith thought perhaps Jag could smell his feet. "What can I do for you, Jag?"

The Waldahud touched the back of one of the polychairs, which configured itself to accommodate his frame. He sat down and began to bark. The translated voice said, "Few of your Earth literary characters appeal to me, but one who does is Sherlock Holmes."

Keith lifted an eyebrow. Rude, arrogant—yes, he could see why Jag might like the guy.

"In particular," continued Jag, "I like his ability to encapsulate mental processes into maxims. One of my favorite sayings of his is, 'The truth is the residue, lacking in likelihood though it may be, that is left behind when those things that cannot be are omitted from consideration.'"

That, at least, brought a smile to Keith's face. What Conan Doyle had actually written was, "Eliminate the impossible, and whatever remains, however improbable, must be the truth," but considering that the words had been translated into Waldahudar then back into English, Jag's version wasn't half bad.

"Yes?" said Keith.

"Well, my original analysis, that the fourth-generation star that appeared here was a one-of-a-kind anomaly, must now be amended, since we've seen a second such star at Rehbollo 376A. By applying Holmes's dictum, I believe I now know where these two green stars, and presumably the other rogue stars as well, have come from." Jag fell silent, waiting for Keith to prod him further.

"And that is?" Keith said, irritated.

"The future."

Keith laughed—but then, he had a barking laugh; perhaps it didn't sound derisive to Waldahud ears. "The future?"

"It is the best explanation. Green

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stars could not have evolved in a Universe that is as young as ours is. A single such star could have been a freak, but multiple ones are highly unlikely."

Keith shook his head. "But perhaps they come from—I don't know—some unusual region of space. Maybe they had been companions of a black hole, and the gravitational stresses had caused fusion reactions to proceed more quickly."

"I thought of such things," said Jag. "That is, I thought of probable alternative scenarios, of which that is not one. But none of them fit the facts. I have now done radiometric dating, based on isotope proportionalities, of the material Longbottle and I scooped from the atmosphere of the green star near us. The heavy-metal atoms in that star are twenty-two billion years old. The star itself is not that old, of course. But many of the atoms it is composed of are."

"I thought all matter was the same age," said Keith.

Jag lifted his lower shoulders. "It's true that, excepting the small amount of matter constantly being created out of energy, and excepting that in certain reactions neutrons can essentially turn into proton-electron pairs, and vice versa, all fundamental particles in the Universe were created shortly after the Big Bang. But the atoms made up of those particles can be formed or destroyed at any time, through fission or fusion."

"Right," said Keith, embarrassed. "Sorry. So you're saying the heavy-metal atoms in the star formed longer ago than the Universe is old."

"That's correct. And the only way that could happen is if the star came to us from the future."

"But—but you said the green stars are billions of years older than any current star could be. You're trying to tell me that these stars have traveled back in time *billions* of years? That seems incredible."

Jag preceded his barking reply with a snort. "The intellectual leap should be in the acceptance of time travel, not the length of time an object is cast back. If time travel can exist at all, then the distance traveled back surely is only a function of appropriate technology and sufficient energy. I submit that any race that has the power to move stars around has both in abundance."

"But I thought time travel was impossible."

Jag lifted all four shoulders. "Until the shortcuts were discovered, instantaneous transportation was impossible. Until the hyperdrive was discovered, faster-than-light travel was impossible. I cannot begin to suggest how time travel might be made to happen, but apparently it *is* happening."

"There are no other explanations?" asked Keith.

"Well, as I said, I *have* considered other possibilities—such as that the shortcuts are now acting as gateways to parallel universes, and that the green stars come from there rather than from our future. But except for their age, they are what one would expect of matter formed in this specific Universe, from our specific Big Bang, under the very specific physical laws that operate here."

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"Very well," said Keith, holding up a hand. "But why send stars from the future back to the past?"

"That," said Jag, "is the first good question you have asked."

Keith spoke through clenched teeth. "And the answer is?"

Jag lifted all four shoulders again. "I have no idea."

As he moved down the dim, cold corridor, Keith accepted that each of the races aboard *Starplex* managed to piss the others off in different ways. One of the things humans did that he knew bugged the hell out of everyone else was spending endless time trying to come up with cute words made from the initial letters of phrases. All the races called such things "acronyms" now, since only the Terran languages had a word for them. Early on in planning *Starplex*, some human came up with the term CAGE for "Common-Access General Environment," referring to the shipboard conditions in those areas that had to be shared by all four races.

Well, it felt like a goddamned cage, thought Keith. Like a dungeon.

All the races could exist in nitrogen-oxygen atmospheres, although Ibs required a much higher concentration of carbon dioxide to trigger their breathing reflex than humans did. Common-area gravity ended up being set at .82 of Earth's—normal for a Waldahud, light for a human or dolphin, and only half of what an Ib was used to. Humidity was kept high, too: Waldahud sinuses seized if the air was too dry. Common-area lighting was redder than humans liked—similar to a bright terrestrial sunset. Further, all lighting had to be indirect. The Ib homeworld was perpetually shrouded in cloud, and the thousands of photosensors in their webs could be damaged by bright lighting.

Even so, there were still problems. Keith moved to one side of the corridor to let an Ib roll by, and, as it passed, one of the two dangling blue tubes coming off the creature's pump pushed out a hard gray pellet, which fell to the corridor floor. The pod's brain had no conscious control over this function; for Ibs, toilet training was a biological impossibility. On Flatland, the pellets were scooped up by scavengers that reprocessed them for the nutrients the Ib had been unable to use. Aboard *Starplex*, little PHARTs the size of human shoes served the same function. One such came zipping along the corridor as Keith watched. It sucked up the dropping and rolled upon its way.

Keith had finally gotten used to the Ibs defecating everywhere; thank God their feces had no discernible odor. But he didn't think he'd ever get used to the cold, or the damp, or any of the other things forced upon them by the Waldahudin--

Keith stopped dead in his tracks. He was coming to a T-intersection in the corridor, and could hear raised voices up ahead: a human male shouting in—Japanese, it sounded like—and the angry barking of a Waldahud.

"PHANTOM," Keith said softly, "translate those voices for me."

A New York accent: "You are weak, Teshima. Very weak. You don't deserve a mate."

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"Have sex with yourself!" Keith frowned, suspecting the computer wasn't doing justice to the original Japanese.

The New York accent again: "On my world, you would be the least significant member of the entourage of the ugliest, puniest female—"

"Identify the speakers," Keith whispered.

"The human is Hiroyuki Teshima, a biochemist," said PHANTOM through Keith's implant. "The Waldahud is Gart Daygaro em-Holf, a member of the engineering staff."

Keith stood there, wondering what to do. They were both adults, and although they reported to him, they could hardly be said to be under his command. And yet—

Middle child. Keith stepped around the corridor. "Guys," he said evenly, "you want to cool it?"

All four of the Waldahud's fists were clenched. Teshima's round face was flushed with anger. "Stay out of this, Lansing," said the human, in English.

Keith looked at them. What could he do? There was no brig to throw them into, no particular reason why they had to listen to his orders about their personal affairs.

"Maybe I could buy you a drink, Hiroyuki," said Keith. "And, Gart, perhaps you'd enjoy an extra leisure period this cycle?"

"What I would enjoy," barked the Waldahud, "is seeing Teshima fired through a mass driver into a black hole."

"Come on, guys," said Keith, stepping closer. "We've all got to live and work together."

"I said stay out of this, Lansing," snapped Teshima. "It's none of your damned business."

Keith felt his cheeks flushing. He couldn't order them apart, and yet he couldn't have people brawling in the corridors of his ship, either. He looked at the two of them—a short, middle-aged human, with hair the color of lead, and a fat, wide Waldahud, with fur the shade of oak wood. Keith didn't know either of them well, didn't know what it would take to placate them. Hell, he didn't even know what they were fighting about. He opened his mouth to say—to say *something*, anything—when a door slid open a few meters away, and a young woman—Cheryl Rosenberg, it was—appeared, wearing pajamas. "For Pete's sake, will you keep it down out here?" she said. "It's night time for some of us."

Teshima looked at the woman, bowed his head slightly, and began to walk away. And Gart, who likewise by nature was deferential to females, nodded curtly and moved in the other direction. Cheryl yawned, stepped back inside, and the door slid shut behind her.

Keith was left standing there, watching the Waldahud's back recede down the corridor, angry with himself for not being able to deal with the situation. He rubbed his temples. *We're all prisoners of biology,* he thought. Teshima unable to turn down the request of a pretty woman; Gart unable to disobey a female's orders.

Once Gart had disappeared from

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sight, Keith headed down the cold, damp hallway. Sometimes, Keith thought, he'd give anything to be an alpha male.

Rissa was sitting at her desk, doing the part of her job she hated—the administrative duties, the burden still called paperwork even though almost none of it was ever printed out.

The door buzzer sounded, and PHANTOM said, "Boxcar is here."

Rissa put down her input stylus and straightened her hair. Funny that, she thought—worrying about whether her hair was messy when the only one going to see it wasn't even human. "Let her in."

The Ib rolled in; PHANTOM slid the polychairs to one side to make room for her. "Please forgive my disturbing you, good Rissa," said the beautiful British voice.

Rissa laughed. "Oh, you're not disturbing me, believe me. Any break is welcome."

Boxcar's sensor web arched up like a ship's sail so that she could see onto Rissa's desktop. "Paperwork," she said. "It does look boring."

Rissa smiled. "That it is. So, what can I do for you?"

There was a long pause—unusual from an Ib. Then, finally, "I've come to give notice."

Rissa looked at her blankly. "Notice?"

Lights danced on her web. "Profound apologies if that is not the correct phrase. I mean to say that, with regret, I will no longer be able to work here, effective five days from now."

Rissa felt her eyebrows lifting. "You're quitting? Resigning?"

Lights played up the web. "Yes."

"Why? I thought you were enjoying the senescence research. If you wish to be assigned to something else—"

"It is not that, good Rissa. The research is fascinating and valuable, and you have honored me by letting me be a part of it. But in five days other priorities must take precedence."

"What other priorities?"

"Repaying a debt."

"To whom?"

"To other integrated bioentities. In five days, I must go."

"Go where?"

"No, not go. *Go*."

Rissa exhaled, and looked at the ceiling. "PHANTOM, are you sure you're translating Boxcar's words correctly?"

"I believe so, ma'am," said PHANTOM into her implant.

"Boxcar, I don't understand the distinction you're making between 'go' and 'go.'" said Rissa.

"I am not going someplace in the physical sense," said Boxcar. "I am going in the sense of exiting. I am going to die."

"My God!" said Rissa. "Are you ill?"

"No."

"But you're not old enough to die. You've told me enough times that Ibs live to be exactly 641. You're only a little over 600."

Boxcar's sensor web changed to a salmon color, but whatever emotion that conveyed apparently had no terrestrial analog, since PHANTOM didn't preface the translation of her next words with a parenthetical comment.

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"I am 605, measured in Earth years. My span is about to be fifteen-sixteenths completed."

Rissa looked at her. "Yes?"

"For offenses committed in my youth, I have been assessed a penalty of one-sixteenth of my lifespan. I am to be ended next week."

Rissa looked at her, unsure what to say. Finally, she settled for simply repeating the word "ended," as if perhaps it, too, had been mistranslated.

"That is correct, good Rissa."

She was quiet again for a moment. "What crime did you commit?"

"It shames me to discuss it," said Boxcar.

Rissa said nothing, waiting to see if the Ib would go on. She did not.

"I've shared a lot of intimate information about myself and my marriage with you," said Rissa, lightly. "I'm your friend, Boxcar."

More silence: perhaps the Ib was wrestling with her own feelings. And then: "When I was a tertiary novice—a position somewhat similar to what you call a graduate student—I reported incorrectly the results of an experiment I was conducting."

Rissa's eyebrows rose again. "We all make mistakes, Boxcar. I can't believe they'd punish you this severely for that."

Boxcar's lights rippled in random patterns. Apparently, they were just signs of consternation; again, PHANTOM provided no verbal translation. Then: "The results were not accidentally misreported." The Ib's mantle was dark for several seconds. "I deliberately falsified the data."

Rissa tried to keep her expression neutral. "Oh."

"I did not think the experiment was of great significance, and I knew—*thought* I knew, anyway—what the results should be. In retrospect, I realize I only knew what I wanted them to be." Darkness; a pause. "In any event, other researchers relied upon my results. Much time was wasted."

"And for this they're going to execute you?"

All the lights on Boxcar's web came on at once—an expression of absolute shock. "It is *not* a summary execution, Rissa. There are only two capital crimes on Flatland: pod-murder and forming a gestalt with more than seven components. My lifespan has simply been shortened."

"But—but if you're 605 now, how long ago did you commit this crime?"

"I did it when I was twenty-four."

"PHANTOM, what Earth-year would that have been?"

"A.D. 1513, ma'am."

"Good God!" said Rissa. "Boxcar, surely they can't punish you for a minor offense committed that long ago."

"The passage of time has not changed the impact of what I did."

"But so long as you're aboard *Starplex*, you're protected by the Commonwealth Charter. You could claim asylum here. We could get you a lawyer."

"Rissa, your concern touches me. But I am prepared to pay my debt."

"But it was so long ago. Maybe they've forgotten."

"Ibs cannot forget; you know that. Because matrices form in our pod brains at a constant rate, we all have eidetic memories. But even if my

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compatriots could forget, it would not matter. I am honor-bound in this."

"Why didn't you say anything about this earlier?"

"My punishment did not require public acknowledgment; I was allowed to live without constant shame. But the terms under which I work here require me to give you five day's notice if I intend to leave. And so now, for the first time in 581 years, I am telling someone of my crime." The Ib paused. "If it is acceptable, I will use the remaining days of my life putting our research in order, so that you and others may continue it without difficulty."

Rissa's head was swimming. "Um, yes," she said at last. "Yes, that would be fine."

"Thank you," said Boxcar. She turned and started to roll toward the door, but then her web flashed once more. "You have been a good friend, Rissa."

And then the door slid open, Boxcar rolled away, and Rissa slumped back in her chair, dumbfounded.

CHAPTER 12

Rissa came to the bridge, wanting to talk to Keith about Boxcar's announcement. But just as she was striding toward his workstation, Rhombus spoke up. "Keith, Jag, Rissa," he said, in his crisp, cool translated voice, "innumerable apologies for the interruption, but I think you should see this."

"What is it?" said Keith.

Rissa took a seat as Rhombus's ropes tickled his console. A section of the holo bubble became framed off in blue. "I wasn't paying enough attention to the real-time scans, I'm afraid," said the Ib, "but I've been reviewing the data we've been recording, and—well, watch this. This is a playback speeded up one thousand times. What you're going to see in the next six minutes took almost all of the time we've been here to occur."

In the framed-off area was a dark-matter sphere, seen from almost directly above its equator. Actually, it wasn't anywhere near a perfect sphere: this one was flattened at the poles. Light and dark latitudinal cloud bands crossed its face. According to the scale bars, this was one of the largest spheres they'd found, measuring 172,000 kilometers in diameter.

"Wait a minute," said Keith. "It's got cloud bands, yet it doesn't seem to be spinning at all."

Rhombus's web twinkled. "I hope the truth does not prove embarrassing, good Keith, but in fact, it's spinning faster than any other sphere we've yet observed. At this point, it's rotating on its axis once every two hours and sixteen minutes—almost five times as fast as Jupiter revolves. The speed is so great that any normal turbulence in the clouds has been smoothed out. And in this speeded-up playback, the image you're seeing is rotating every eight seconds." Rhombus snaked out a rope and flicked a control. "Here, let me have the computer put a reference mark on the equator. See that orange dot? It's at an arbitrary zero degrees of longitude."

The orange spot whipped across the equator, disappeared around back, reappeared four seconds later, and traversed the visible face again. After a

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few cycles. Jag barked out, "Are you increasing the playback speed?"

"No good Jag," said Rhombus. "Speed is constant."

Jag gestured at the digital clocks. "But that dot of yours took only seven seconds to go around that time."

"Indeed," said Rhombus. "The sphere's actual rate of rotation is increasing."

"How can that be?" asked Keith. "Are other bodies interacting with it?"

"Well, yes, the other spheres are all having an effect on it—but that's not the cause of what we're seeing," said Rhombus. "The increased rotation is *internally* generated."

Jag's head was bent down to his console, running quickie computer models. "You can't get increased spin unless you pump energy into the system. There must be some complex reactions going on inside the sphere, ultimately fueled by some outside source, and—" He looked up, and let out a high-pitched bark, which PHANTOM translated as "Expression of astonishment."

In the blue-framed-off area, the dark-matter object had started to pinch in at its equator. The northern and southern halves were no longer perfect hemispheres, but rather they curved in a little before they joined each other. The orange reference dot was now whipping around the smaller waist even faster than before.

As the sphere continued to rotate with increasing speed, the pinching-off became more and more pronounced. Soon the profile of the object had taken on a figure-eight shape.

Rissa rose to her feet, and stood staring, mouth agape. The equator was now so narrow that the orange dot covered almost a quarter of its width. Rhombus touched some keys and the dot disappeared, replaced by separate orange dots on the equators of each of the two joined spheres.

The view in the frame went dark. "Please forgive this," said Rhombus. "Another dark-matter sphere moved into our line-of-sight, obscuring the view. At this playback speed, we lose the picture for about fourteen seconds. Let me jump past that."

Ropes touched the ExOps console. When the image reappeared, the two spheres were joined by only about a tenth of the original globe's diameter. Everyone watched, rapt, silence broken only by the gentle whir of the air-conditioning equipment, as the process reached its inevitable conclusion. The two spheres broke free from each other. One immediately started curving toward the bottom of the frame; the other, toward the top. As they distanced themselves from each other, the orange reference dots on each of their equators began to take longer and longer to complete their paths—the rotation was slowing down.

Rissa turned to face Keith, her eyes wide. "It's like a cell," she said. "A cell undergoing mitosis."

"Exactly," said Rhombus. "Except that in this case, the mother cell is some 170,000 kilometers in diameter. Or, at least it was before this started happening."

Keith cleared his throat. "Excuse me," he said. "Are you trying to tell me that those things out there are

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alive? That they're living cells?"

"I finally saw the recordings Jag's atmospheric probe had made," said Rissa. "Remember that blimp-like object it saw as it went into the atmosphere? I'd idly thought that it might be an individual lifeform—a gas-bag creature, floating in the clouds. Earth scientists in the 1960s proposed just such lifeforms for Jupiter. But such blimps could just as easily be organelles—discrete components within a larger cell."

"Living beings," said Keith, incredulous. "Living beings almost two hundred thousand kilometers in size?"

Rissa's voice was still full of awe. "Perhaps. In which case, we've just seen one of them reproduce."

"Incredible," said Keith, shaking his head. "I mean, we aren't just talking about giant creatures. And we aren't just talking about lifeforms living freely in open space. We're talking about living beings made of *dark matter*." He turned to his left. "Jag, is that even possible?"

"Possible that dark matter—or some portion of it—is alive?" The Waldahud shrugged all four shoulders. "Much of our science and philosophy tells us that the Universe should be teeming with life. And yet, so far, we've only found three worlds on which life has arisen. Perhaps we've just been looking in the wrong places. Neither Dr. Delacorte nor I have yet figured out much about dark-matter meta-chemistry, but there *are* lots of complex compounds in those spheres."

Keith spread his arms in an appeal for basic common sense, and looked around the bridge, trying to find someone else as lost by all this as he was.

And then an even bigger thought hit him, and he leaned back in his chair for a moment. Then he touched his comm control panel, selecting a general channel. "Lansing to Hek," he said.

A hologram of Hek's head appeared in a second framed-off part of the starscape. "Hek here."

"Any luck pinpointing the sources of those radio transmissions?"

Keith imagined the Waldahud's lower shoulders moving outside the camera's field of view. "Not yet."

"You said there were over two hundred separate frequencies upon which you were finding apparently intelligent signals."

"That's right."

"How many? Exactly how many?"

Hek's face turned to a profile view, showing his projecting snout, as he consulted a monitor. "Two hundred and seventeen," he said. "Although some are much more active than others."

Keith heard Jag, on his left, repeat the same bark of astonishment he'd made earlier.

"There are," said Keith, slowly, "precisely 217 separate Jupiter-sized objects out there." He paused, backtracking away from his own conclusion. "Of course, gas-giant worlds like Jupiter are often sources of radio emissions."

"But these are spheres of dark matter," said Lianne. "They're electrically neutral."

"They are not pure dark matter," said Jag. "They're permeated with bits

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of regular matter. The dark matter could interact with protons in the regular matter through the strong nuclear force thereby generating EM signals."

Hek lifted his upper shoulders. "That might work," he said. "But each sphere is broadcasting on its own separate frequency, almost like. . . ." The Brooklyn-accented voice trailed off.

Keith looked at Rissa, and could see that she was thinking the same thing. He lifted his eyebrows. "Almost like separate voices," he said at last, finishing the thought.

"But there aren't 217 objects anymore," said Thor, turning around. "There are 218 now."

Keith nodded. "Hek, do another inventory of signals. See if there's new activity at a frequency just above or just below the block of frequencies you've identified as being active."

Hek tilted his head as he worked his controls up on deck one. "Just a second," he said. "Just a second." Then: "Gods of the mud and the moons, yes! Yes, there is!"

Keith turned to Rissa, grinning. "I wonder what baby's first words were."

Epsilon Draconis

Keith hadn't seen Glass reenter the docking bay, but when he looked up, there he was, coming closer, transparent legs carrying him over the fields of grass and four-leaf clover. His walking was fluid, beautiful, giving the appearance of being in slow-motion even though he was moving at normal speed. The hint of aquamarine—the only color in his clear body—was eye-catching.

Keith thought about rising to his feet but instead simply looked up at the transparent man, sun glinting off the latter's body and egg-shaped head.

"Welcome back," said Keith.

Glass nodded. "I know, I know. You're frightened. You hide it well, but you're wondering how much longer I will keep you here. It won't be long, I promise. But there is something else I want to explore with you before you go."

Keith lifted his eyebrows, and Glass sat down, leaning his back against a nearby tree. Whatever his body was made of wasn't glass. His tubular torso didn't magnify the patterns of the bark on the other side of it. Rather, they were seen with only slight distortion.

"You are angry," said Glass, simply.

Keith shook his head. "No, I'm not. You've treated me well so far."

The wind-chime laughter. "No, no. I don't mean you're angry with me. Rather, you're angry in general. There's something inside you, something down deep, that has hardened your heart."

Keith looked away.

"I'm right, aren't I?" said Glass. "Something that has upset you greatly."

Silence.

"Please," said Glass. "Share it with me."

"It was a long time ago," said Keith. "I—I should be over it, I know, but. . . ."

"But it festers still, doesn't it? What

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is it? What changed you so?"

Keith sighed, and looked around. Everything was so beautiful, so peaceful. He couldn't remember the last time he'd sat outside among the grass and trees, and just enjoyed the surroundings, just—just relaxed.

"It has to do with Saul Ben-Abraham's death," said Keith.

"Death," repeated Glass, as if Keith had used another unknown word like "quixotic." He shook his see-through head. "How old was he when he died?"

"It was eighteen years ago now. He would have been twenty-seven."

"A heartbeat," said Glass.

There was silence between them for a moment, Keith recalling his reaction when Glass had dismissed his two decades of marriage in a similar fashion. But Glass was right this time. Keith nodded.

"How did Saul die?" asked Glass.

"It—it was an accident. At least, that's what the HuGo decided. But, well, I always thought it was swept under the rug. You know: deliberately suppressed. Saul and I were living on Tau Ceti IV. He was an astronomer; I was a sociologist, doing a post-doctoral fellowship studying the colonists there. He and I had been friends since our undergrad days; we'd been roommates at UBC. And we had a lot in common—both liked to play handball and go, both acted in student theater, both had the same tastes in music. Anyway, Saul discovered the Tau Ceti shortcut, and we sent a small probe through it to Shortcut Prime. New Beijing was a mostly agricultural colony back then, not the thriving place it is now. Of course, it hadn't yet acquired the New Beijing nickname. It was just 'the Silvanus colony' then; Silvanus is the name of Tau Ceti's fourth planet. Anyway, they didn't have many sociologists there, so I ended up in charge of trying to figure out what effect the discovery of the shortcut network would have on human culture. And then the Waldahud starship popped through. A first-contact team had to be hastily assembled; even under hyperdrive, it would take six months for people to arrive from Earth. Saul and I ended up being part of the party that went up to meet the ship, and. . . ." Keith trailed off, closed his eyes, shook his head ever so slightly.

"Yes?" said Glass.

"They said it was an accident. Said they'd misinterpreted. When we came face to face with the Waldahudin for the first time, Saul was carrying a holographic camera unit. He didn't aim it at the pigs, of course—no one could be that stupid. He was just holding it at his side, and then, with a flick of his thumb, he turned it on." Keith sighed, long and loud. "They said it looked like a traditional Waldahud hand weapon—same basic shape. They thought Saul was readying a weapon to fire on them. One of the pigs was carrying a sidearm, and he shot Saul. Right in the face. His head exploded next to me. I—I got splattered with . . . with. . . ." Keith looked away, and was quiet for a long moment. "They killed him. The best friend I ever had, they killed him."

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He stared at the ground, plucked a few four-leaf clovers, looked at them for a moment, then threw them away.

They were quiet for several moments. Crickets chirped, and birds sang. Finally, Glass said, "That must be difficult to carry around with you."

Keith said nothing.

"Does Rissa know?"

"She does, yes. We were already married at that point; she'd come to Silvanus to try to fathom why it didn't have any native life, despite apparently having conditions that should have given rise to it, according to our evolutionary models. But I rarely talk about what happened with Saul—not with her, or with anyone else. I don't believe in burdening those around me with my suffering. Everyone has their own stuff to deal with."

"So you keep it inside."

Keith shrugged. "I try for a certain stoicism—a certain emotional restraint."

"Commendable," said Glass.

Keith was surprised. "You think so?"

"It's the way I feel, too. I know it's unusual, though. Most people live, if you'll pardon me my humor, transparent lives." Glass gestured at his own see-through body. "Their private self is their public self. Why are you different?"

Keith shrugged. "I don't know. I've always been this way." He paused again, thinking for a long time. Then: "When I was about nine or so, there was a bully in my neighborhood. Some big oaf, probably thirteen or fourteen. He used to pick up kids and drop them into this thorn bush in the park. Well, everyone would kick and scream and cry while he was doing this, and he seemed to feed off that. One day, he came after me—grabbed me when I was playing catch, or something like that. He picked me up, carried me over to the bush, and dumped me in. I didn't struggle. There was no point; he was twice as big as me, and there was no way I could get away. And I didn't scream or cry, either. He dumped me in, and I simply got myself out. I had a few scrapes and cuts from it, but I didn't say anything. He just looked at me for about ten seconds, then said, 'Lansing, you've got balls.' And he never touched me again."

"So this internalizing is a survival mechanism?" asked Glass.

Keith shrugged. "It's enduring what you have to endure."

"But you don't know where it came from?"

"No," said Keith. Then, a moment later, "Well, actually, yes. I suppose I do. My parents were both quite argumentative, and had short fuses. You'd never know when one of them was going to blow up over something. Publicly, privately, it didn't make any difference. You couldn't even make polite conversation without risking an explosion from one of them. We'd have family dinners together every night, but I always was silent, hoping we could just get through it, just once, without it being unpleasant, without one of them

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storming away from the table, or yelling, or saying something nasty."

Keith paused again. "In fairness, there were other issues in my parents' relationship that I didn't understand when I was a child. They'd started as a two-career family, but automation kept eliminating more and more jobs as the years went by—this was back before they outlawed true artificial intelligence. The Canadian government changed the tax laws so that second income-earners in a family were taxed at a 110 percent rate. It was a move designed to spread out what work there was amongst the most families. Dad had been making less than mom, so he was the one who stopped working. I'm sure that had a lot to do with his anger. But all I knew was that my parents were taking out their anger and frustration on everyone around them, and, even as a kid, I vowed never to do that."

Glass was rapt. "Amazing," he said. "It all makes sense."

"What does?" asked Keith.

"You."

CHAPTER 13

Keith's mind was reeling. So many discoveries, so much happening. He drummed his fingers on his bridge workstation for a moment, thinking. And then: "OK, people, what now?"

The front row of workstations all rotated around on their individual pedestals so that they faced the back row: Lianne was facing Jag, Thor was facing Keith, and Rhombus was facing Rissa. Keith looked at each member of his bridge staff in turn. "We've got almost an embarrassment of riches here," he said. "First, there's the mystery of the stars erupting from the shortcuts—stars that Jag thinks come from the future. As if that's not a big enough puzzle to try to figure out, we've also stumbled upon life—*life!*—made out of dark matter." Keith looked from face to face. "Given the complexity of the radio signals Hek's been picking up, there's a chance—a small one, I grant you—that we're even looking at first contact with intelligent life. Rissa, it would have been crazy to say this yesterday, but let's make the dark-matter investigations the province of the Life Sciences division."

She nodded.

Keith turned to Jag. "The stars coming out of the shortcuts, on the other hand, may pose a threat to the Commonwealth. If you're right, Jag, and they *are* coming from the future, then we've got to find out why they're coming back. Is it by deliberate design? If so, is it for a malevolent purpose? Or is it just an accident? A globular cluster, say, colliding with a shortcut billions of years from now, and overloading it somehow so that its constituent stars are spewed back to here?"

"Well," barked Jag, "a globular cluster wouldn't pass through a shortcut. Only one of its member stars would."

"Unless," said Thor, sounding a bit feisty, "that globular cluster was enclosed in a sort of super Dyson sphere—a shell around the entire assembly of stars. Imagine something like that touching a shortcut billions of years from now. The shell could break apart while traversing the gate,

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and send the component stars scattering out of different exit points."

"Ridiculous," said Jag. "You humans always reinforce each other in even your wildest fantasies. Take your religions, for instance—"

"Enough!" snapped Keith, bringing his open palm down loudly on the edge of his workstation. "Enough. We're not going to get anywhere squabbling." He looked at the Waldahud. "If you don't like Thor's suggestion, then make one of your own. Why are the stars coming back here from the future?"

Jag was facing the director, but only his right eyes were looking at Keith; the left pair was scanning the surroundings, an instinctual precursor to a fight. "I don't know," he said at last.

"We need an answer," said Keith, his voice still edged.

"Interrupting in all politeness," said Rhombus. "Offense not intended and hopefully not taken."

Keith turned to face the Ib. "What is it?"

"Perhaps you are asking the wrong person. No slight is intended of good Jag, of course. But if you want to know why the stars are being sent back in time, then the person to ask is the person who is sending them back."

"You mean ask some person in the future?" Keith said. "How can we possibly do that?"

The Ib's mantle twinkled. "Now that *is* a question for good Jag," he said. "If material from the future can exit the shortcut in the past, can we then send something from the past into the future?"

Jag was quiet for a second, thinking. But then he moved his lower shoulders. "Not as far as I can tell. Every computer simulation I've done shows that any object entering the shortcut in the present gets shunted to another present-day shortcut. Assuming the rogue stars are being sent back by conscious design, I don't know how whoever is controlling the shortcuts is doing it, and I have no idea how to send something forward."

"Ah, good Jag," said Rhombus, "forgive me, but there is of course one way to send something forward."

"And what's that?" Keith asked.

"A time capsule," said the Ib. "You know: just make something that will last. Eventually, without our doing anything special, it will end up in the future through the natural passage of time."

Jag and Keith looked at each other. "But—but Jag says the stars are coming from *billions* of years in the future," Keith said.

"In fact," said the Waldahud, "if I had to guess, I would say they come from something like ten billion years from now."

Keith nodded, turning back to face Rhombus. "That's double the current age of any of the Commonwealth homeworlds."

"True," said the Ib. "But, forgive me, despite what you humans think, neither Earth nor the other homeworlds were created by deliberate design. Our time capsule would be."

"A time capsule that would last ten billion years. . . ." said Jag, clearly intrigued. "Perhaps . . . perhaps if it

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were made out of extremely hard material, like . . . like diamond, but without the cleavage planes. But even if we made such a thing, there is no guarantee that anyone would ever find it. And, besides, this part of the galaxy will rotate around the core forty-odd times before then. How do we possibly keep the object from drifting away during all that time?"

Lights danced on Rhombus's sensor web. "Well, assume that this particular shortcut will continue to exist for the next ten billion years; that's a fair assumption, since it's here now, and must also still exist at the time the star was pushed through it. So, make our time capsule self-repairing—the nanotech lab should be able to come up with something—and have it hold position near this shortcut."

"And then just hope that someone will notice it when they come by here in the future to use the shortcut?" asked Keith.

"It may be more than that, good Keith," said Rhombus. "It may be that they come by here to *build* the shortcut. The shortcuts may have been created in the future, and had their exit points extruded into the past. If their real purpose is to shunt stars back here, then that's a likely scenario."

Keith turned to Jag. "Objections?"

The Waldahud lifted all four shoulders. "None."

He turned back to Rhombus. "And you think this will work?"

A tiny flash of light on the Ib's sensor web. "Why not?"

Keith thought about it. "I suppose it's worth a try. But ten billion years—all of the Commonwealth races might be extinct by then. Hell, they'll *probably* be extinct by then."

Lights moved up Rhombus's web; a nod of assent. "So we'll have to contrive our message in symbolic or mathematical language. Ask our good friend Hek to devise something. As a radio astronomer involved with searching for alien intelligence, he's an expert in designing symbolic communication. To use an expression that both your people and mine share, this project will be right up his alley."

The bridge was bustling with activity, and there was plenty of work to be done. But Jag and Hek were visibly flagging. Although they didn't do the theatrical yawns humans were famous for, their nostrils were dilating rhythmically, a physiological response which amounted to the same thing.

Keith thought for a moment that he could pull an all-nighter. Hell, he'd done that often enough at university. But university had been a quarter-century ago, and he had to admit that he, too, was exhausted.

"Let's call it a night," he said, rising from his workstation. The indicators on it went dark as he did so.

Rissa nodded and rose as well. The two of them headed toward one of the bridge's hologram-shrouded walls. The door opened, exposing the corridor beyond. They headed down toward the elevator station. A car was waiting for them—PHANTOM had routed one there as soon as they had started down the corridor. Keith got in, followed by Rissa. "Deck eleven," he said, and PHANTOM chirped an acknowledgment. They turned

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around, just in time to catch sight of Lianne Karendaughter jogging down the corridor toward them. PHANTOM saw her too, of course, and held the elevator door open until she arrived. Lianne smiled at Keith as she got in, then called out her floor number. Rissa affixed her gaze on the wall monitor that showed the current level's deck plan.

Keith had been married to Rissa too long not to be sensitive to her body language. She didn't like Lianne—didn't like her standing this close to Keith, didn't like being in a confined space with her.

The elevator began to move. On the monitor, the arms of the floor plan began to contract. Keith breathed deeply—and realized, perhaps for the first time, that he missed the subtle smell of perfume. Another concession to the damn pigs, and their hypersensitive noses. Perfume, cologne, scented aftershave—all were banned aboard *Starplex*.

Keith could see the reflection of Rissa's face in the monitor screen, see the tight lines at the corners of her mouth, see the tension, the hurt.

And Keith could also see Lianne. She was shorter than he was, and her lustrous blonde hair half-shielded her exotic young face. If they'd been alone, Keith might have chatted with her, told her a joke, smiled, laughed, maybe even touched her arm lightly as he made a comment. She was so—so *alive*; talking to her was invigorating.

Instead, he said nothing. The deck-number indicator continued to count down. Finally, the car hummed to a stop on the floor containing Lianne's apartment.

"Good night, Keith," said Lianne, smiling up at him. "Good night, Rissa."

"Good night," replied Keith. Rissa nodded curtly.

Keith was able to watch her walk down the corridor for a few seconds before the door closed behind her. He'd never been to her apartment. He wondered how she had it decorated.

The elevator continued to ascend briefly and then it stopped again. The door opened, and Keith and Rissa walked the short distance to their apartment.

Once they were inside, Rissa spoke—and Keith could hear in her voice that she was speaking against her better judgment. "You're quite fond of her, aren't you?"

Keith weighed all the possible answers. He had too much respect for Rissa's intelligence to try to get away with saying, "Who?" After a moment's hesitation, he decided simple honesty was the best policy. "She's bright, charming, beautiful, and good at her job. What's not to like?"

"She's twenty-seven," said Rissa, as if that were an indictable offense.

Twenty-seven! thought Keith. Well, there it was. A concrete number. But—twenty-seven. Jesus Christ. . . . He took off his shoes and socks, and lay down on the couch, letting his feet air out.

Rissa sat down opposite him. Her face was a study in thought, as if she were deciding whether to pursue the topic further. Evidently she chose not to, and instead changed the subject.

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"Boxcar came to see me today."

Keith wriggled his toes. "Oh?"

"She's quitting."

"Really? Got a better offer somewhere else?"

Rissa shook her head. "She's going to discorporate next week. She was assessed a penalty of one-sixteenth of her lifespan because she wasted some people's time almost six hundred years ago."

Keith was quiet for a few moments. "Oh."

"You don't sound surprised," said Rissa.

"Well, I've heard of the procedure. Never quite made sense to me, the way Ibs are so obsessive about wasted time. I mean, they live for centuries."

"To them, it's just a normal lifespan. They don't think of it as inordinately long, of course." A pause. "You can't let her go through with it."

Keith spread his arms. "I don't know that I have any choice."

"Dammit, Keith. The execution is to take place here, aboard *Starplex*. Surely you have jurisdiction."

"Over ship's business, sure. Over this, well . . ." He looked up at the ceiling. "PHANTOM, what powers do I have in this area?"

"Under the Articles of Commonwealth jurisprudence, you are obliged to recognize all sentences imposed by the individual member governments," said PHANTOM. "The Ib practice of exacting penalties equal to a portion of the standard lifespan is specifically excluded from the section of the Articles that deals with cruel and unusual punishment. Given that, you have no power to interfere."

Keith spread his arms, and looked at Rissa. "Sorry."

"But what she did was so minor, so insignificant."

"You said she fudged some data?"

"That's right, when she was a student. A stupid thing to do, granted, but—"

"You know how the Ibs feel about wasted time, Rissa. I imagine others relied on her results, right?"

"Yes, but—"

"Look, the Ibs come from a planet that's perpetually shrouded in cloud. You can't see the stars or their moons from the surface, and their sun is only a bright smudge behind the clouds. Despite that, by studying tides in those shallow puddles that pass for oceans there, they managed to work out the existence of their moons. They even managed to deduce the existence of other stars and planets, all before any of them had ever traveled above their atmosphere. The things they've figured out would have been impossible for humans, I bet. It's only because they live for such a long time that they were able to puzzle them through; a shorter-lived race on such a world would probably never have realized that there was a universe out there. But to accomplish what they have, they have to be able to trust each other's observations and results. It all falls apart if someone is monkeying with the data."

"But no one could possibly still care about what she did after all this time. And—and I need her. She's an important part of my staff. And she's my friend."

Keith spread his arms. "What

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would you have me do?"

"Talk to her. Tell her she doesn't have to go through with this."

Keith scratched his left ear. "All right," he said, at last. "All right."

Rissa smiled at him. "Thank you. I'm sure she'll—"

The intercom chimed. "Colorosso to Lansing," said a woman's voice. Franca Colorosso was the delta-shift InOps officer.

Keith tipped his head up. "Open. Keith here. What is it, Franca?"

"A watson has come through from Tau Ceti, with a news report I think you should see. It's old news, in a way—sent from Sol to Tau Ceti by hyperspace radio sixteen days ago. As soon as Grand Central received it, they relayed it to us."

"Thanks. Pipe it down to my wall monitor, please."

"Doing so. Close."

Keith and Rissa both turned to face the wall. It was the BBC World Service, being read by an East Indian man with steel-gray hair. "Tensions," he said, "continue between two of the Commonwealth governments. On one side: the United Nations of Sol, Epsilon Indi, and Tau Ceti. On the other, the Royal Government of Rehbollo. Rumors of further deterioration in the situation were fueled today by the terse announcement that Rehbollo is closing three more embassies—New York, Paris, and Tokyo. Coupled with the four other closings a week ago, this leaves only the Ottawa and Brussels embassies open in all of Sol system. The consular staffs from the embassies closed today have already departed on Waldahud starships for the Tau Ceti shortcut."

The view cut to a beefy Waldahud face. The super at the bottom of the screen identified him as Plenipotentiary Daht Lasko em-Wooth. He spoke in English, without aid of a translator—a rare feat for a member of his race. "It's with great regret that economic necessity has forced us into this move. As you know, the economies of all the Commonwealth races have been thrown into disarray by the unexpected development of interstellar commerce. Reducing the number of our embassies on Earth simply represents an adjustment to the times."

The screen changed to show a middle-aged African woman, identified as Rita Negesh, Earth-Wald Political Scientist, Leeds University. "I don't buy that—not for a minute," she said. "If you ask me, Rehbollo is recalling its ambassadors."

"As a prelude to what?" asked an off-camera male voice.

Negesh spread her arms. "Look, when humanity first moved out into space, all the pundits said the Universe is so big and so bountiful, there was no possibility of material conflict between separate worlds. But the shortcut network changed all that; it forced us up close with other races, perhaps before we or they were ready."

"And so?" said the unseen questioner again.

"And so," said Negesh, "if we are moving toward an . . . an incident, it may not just be over economic issues. It may be something more basic—the simple fact that humans and Wal-

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dahudin get on each others' nerves."

The wall monitor changed back to the hologram of Lake Louise. Keith looked at Rissa, and let out a long sigh. "An 'incident,'" he said, repeating the word. "Well, at least we're both too old to be drafted."

Rissa looked at him for a long moment. "I think that makes no difference," she said, at last. "I think we're already at the front lines."

CHAPTER 14

Keith always enjoyed taking an elevator to the docking bays. The car dropped down to deck thirty-one, the uppermost of the ten decks that made up the central disk. It then began a horizontal journey along one of the four spokes that radiated out from there to the outer edge of the disk. But the spokes were transparent, as were the elevator cab's walls and floors, and so the passengers were treated to a view looking down on the vast circular ocean. Keith could see the dorsal fins of three dolphins swimming along just below the surface. Agitators in the ocean walls and central shaft produced respectable half-meter waves; dolphins preferred that to a calm sea. The radius of the ocean deck was ninety-five meters; Keith was always staggered by the amount of water contained there. The roof was a real-time hologram of Earth's sky, with towering white clouds moving against a background of that special shade of blue that always tugged at Keith's heart.

The elevator finally reached the edge of the ocean and passed through into the prosaic tunnels of the engineering torus. Once it came to the outer edge of the torus, it descended the nine levels to the floor of the docking bays. Keith disembarked, and walked the short distance to the entrance to bay nine. As soon as he entered, he saw Hek, the symbolic-communications specialist, and a slim human named Shahinshah Azmi, the head of the material-sciences department. Between them was a black cube measuring a meter on a side. The cube was resting on a pedestal that brought it up to eye level. Keith walked over to them.

"Good day, sir," said the ever-polite Azmi, in a flat voice. Keith knew from old movies how musical Indian accents used to be; he missed the rich variety that human voices had had before instantaneous communications had scorched out all the differences. Azmi gestured at the cube. "We've built the time capsule out of graphite composite with a few radioactives added. It's solid except for the self-repairing hyperspatial sensor, which will lock onto the shortcut, and the starlight-powered ACS system for helping the cube hold position relative to it."

"And what about the message for the future?" asked Keith.

Hek pointed to one of the cube's sides. "We've incised it into the cube's faces," he said, his barking echoing in the bay. "It begins on this side. As you can see, it consists of a series of boxed examples. Two dots plus two dots equals four dots; a question with its answer. The second box, here, has two dots plus two dots, and a symbol. Since any arbitrary symbol would do,

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we just used the English question mark, but without the separate dot underneath; that might confuse one into thinking it was two symbols rather than one. Anyway, that gives us a question and a symbolic representation of the fact that the answer is missing. The third box shows the question symbol, the symbol I've established for 'equals,' and four dots, the answer. So that box says, 'The answer to the question is four.' Do you see?"

Keith nodded.

"Now," continued Hek, "having established a vocabulary for our dialog, we can ask our real question." He waddled around to the opposite side of the cube, which was also incised with markings.

"As you can see," said Hek, "we have two similar boxes here. The first one has a graphic representation of the shortcut, with a star emerging from it. See that scale mark showing the width of the star, and the series of horizontal and vertical lines beneath? That's a binary representation of the star's diameter in units of the box's width, in case there's any confusion about what the image represents. And then there's the equals symbol, and the question symbol. So it says, 'shortcut with star emerging from it equals what?' And beneath it is the question symbol, the equals symbol, and a large blank space: 'The answer to the above question is. . . ,' and a space implying that we want a reply."

Keith nodded slowly. "Clever. Good work, gentlemen."

Azmi pointed to one of the cube's other faces. "On this face, we've incised information about the periods and relative positions of fourteen different pulsars. If the shortcut makers in the future—or whoever it is who finds this—have records going back this far in time, they'll be able to identify the specific year in which the cube was created from that information."

"Beyond that," said Hek, "they might also assume, quite reasonably, that the cube had been created shortly after the green star emerged from this shortcut—and presumably they'll know what date they sent that star back to, as well. In other words, they've got two independent ways of determining when to send any reply back to."

"And this will work?" Keith asked.

"Oh, probably not," said Azmi, smiling. "It's just a bottle in the ocean. I don't seriously expect any results, but I suppose it's worth a try. Still, as Dr. Magnor has told me, if we don't get a good explanation, and if we decided the stars are a threat, we can use the Waldahud space-flattening technique to evaporate the shortcuts. Granted, stars may be popping out of thousands of exit points, so we probably can't do much to stop them. But if they know we have the capability to interfere to some degree, perhaps they'll provide an explanation rather than have us do that."

"Very good," said Keith. "But what will make the cube conspicuous? How can you be sure someone will find it?"

"That's the hardest part of all," barked Hek. "There are only a few ways to get something to stand out. One is to make it reflective. But no

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matter what we make this box out of, it will have to endure perhaps ten billion years of scouring by interstellar dust. Granted, that's only a few microscopic impacts per century, but the net effect over that much time would be to dull any reflective surface.

"The second possibility we'd considered was to make the time capsule big, so that it's eye-catching, or heavy, so that it warps space-time. But the bigger you make it, the more likely it is to be destroyed by a meteor collision.

"The final possibility was to make it loud—you know, by broadcasting a radio signal. But that requires a power source. Of course, right now the green star is close by, and we can use simple solar cells to generate electricity from it, but the star has a respectable proper motion relative to the shortcut. In just a few thousand years, it'll be a full light-year from here, much too far away to provide significant power. And any internal power source we use would exhaust its fuel, or have most of its radioactives decay to lead, long before the target date."

Keith nodded. "But you said you were using starlight converted to electricity to power the attitude-control system?"

"Yes. But there's almost no spare power for a beacon of any sort. We're just going to have to assume that whoever built the shortcuts will have detectors that will find the cube regardless."

"And if they don't?"

Hek moved all four shoulders up and down in a shrug. "If they don't—well, we've hardly lost much by trying."

"All right," said Keith. "It looks good to me. Is this a prototype, or the actual time capsule?"

"We'd intended it as just a prototype, but everything came together perfectly," said Azmi. "I say we might as well go ahead and use this one."

Keith turned to Hek. "What about you?"

The Waldahud barked once. "I concur."

"Very well," said Keith. "How do you propose to launch it?"

"Well, it has nothing but ACS jets," said Azmi. "And I don't dare put it out there on its own with those dark-matter creatures swarming around; it would probably get sucked into their gravity. But we've already seen that the dark-matter beings have some mobility, so I'm assuming they won't be in this exact spot forever. I've programmed a standard payload carrier to take the cube away from here, but come back in a hundred years and dump it about twenty klicks from the shortcut. After that, the time capsule's own ACS jets should be able to hold it in place relative to the exit point."

"Excellent," said Keith. "Is the launcher ready, too?"

Azmi nodded.

"Can you launch it from down here?"

"Of course."

"Let's do so, then."

The three of them exited the bay, and took a lift up to the docking control room, which had angled windows that overlooked the interior of the cavernous hangar. Azmi took a seat in front of a console and began

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operating controls. Under his command, a motorized flatbed rolled into the bay, carrying a cylindrical payload carrier. Mechanical arms mated the cube to the clamps on the front of the carrier.

"Depressurizing the bay," said Azmi.

Shimmering force-field sheets started to close in from three of the four walls and the floor and ceiling, forcing the air in the bay out through vents in the rear wall. When all the air had been swept up and compressed into tanks, the force-field sheets collapsed, leaving an interior vacuum.

"Opening space door," Azmi said, operating another control. The segmented curving outer wall began to slide up into the ceiling. Blackness became visible, but the glare of the bay's internal lighting washed out the stars.

Azmi touched some more buttons. "Activating time-capsule electronics." He then tapped a key, initiating a preprogrammed sequence for the tractor-beam emitter mounted on the rear bay wall. The payload carrier lifted off the flatbed, flew over the floorplates, passed the spindly form of a repair skiff that was parked inside the bay, and headed out into space.

"Powering up carrier," said Azmi. The cylinder's end lit up with the glow of thrusters, and the contraption rapidly receded from view.

"And that," said Azmi, "is that."

"Now what?" asked Keith.

Azmi shrugged. "Now, just forget about it. Either this will work, or it won't—probably won't."

Keith nodded. "Excellent work, guys. Thank you. It's—"

"Rissa to Lansing," said a voice over the speakers.

Keith looked up. "Open. Hi, Rissa."

"Hi, hon. We're ready to take our first whack at communicating with the dark-matter creatures."

"I'm on my way. Close." He smiled at Azmi and Hek. "Sometimes, you know, my staff is almost *too* efficient."

Keith rode up to the bridge and took his seat in the center of the back row. The holographic bubble was filled not with the normal space view but rather with red circles against a pale white background, a plot of the locations of the dark-matter spheres.

"OK," said Rissa. "We're going to try communicating with the dark-matter beings using radio and visual signals. We've deployed a special probe that will do the actual signaling. It's located about eight light-seconds off the starboard side of the ship. I'm going to operate it by comm laser. Of course, the dark-matter beings may already have detected our presence, but, then again, they may not have. And just in case the dark-matter beings turn out to be the Slammers, or something equally nasty, it seems prudent to have their attention drawn to an expendable probe rather than *Starplex* itself."

"'Dark-matter beings,'" repeated Keith. "That's a bit of a mouthful, no? Surely we can come up with a better name for them."

"How about 'darkies'?" said Rhombus, helpfully.

Keith cringed. "That's not a good idea." He thought for a second, then looked up, grinning. "What about

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MACHO men?"

Jag rolled all four eyes and made a disgusted bark.

"How does 'darmats' sound?" asked Thor.

Rissa nodded. "Darmats it is." She addressed everyone in the room. "Well, as you all know, Hek has been cataloging the signal groups he's picked up from the darmats. On the assumption that each group is a word, we've identified the single most commonly used one. For the first message, I'm going to send a looping repeat of that word. We assume it's innocuous—the darmat equivalent of 'the,' or some such. Granted, the repetition will convey no meaningful information, but with luck the darmats will recognize it as an attempt to communicate." She turned to Keith. "Permission to proceed, Director?"

Keith smiled. "Be my guest."

Rissa touched a control. "Transmitting now."

Lights flashed on Rhombus's web. "Well, that certainly did something," he said. "The conversation level has increased dramatically. All of them talking at once."

Rissa nodded. "We're hoping they'll triangulate on the probe as the source."

"I'd say they've figured it out," said Thor, a moment later, pointing at the display. Five of the world-sized creatures had begun to move toward the probe.

"Now the tricky part begins," said Rissa. "We've got their attention, but can we communicate with them?"

Keith knew that if anyone could pull it off, it would be his wife, who had been part of the team that had first communicated with the Ibs. That effort had started with a simple exchange of nouns—this pattern of lights meant "table," that one meant "ground," and so on. Even then, there had been difficulties. The Ib body was so different from the bipedal human design that for many concepts they had no terms: stand up, run, sit down, chair, clothing, male, female. And because they'd always lived under cloud cover, for countless other ideas—day, night, month, year, constellation—there were no common Ibese words. Meanwhile, the Ibs had been trying to convey concepts that were central to their lives: biological gestalt, all-encompassing vision, and the many metaphorical meanings for roll ahead and roll back.

But that exercise had been a piece of cake compared to communicating with world-sized beings. Indeed, the Ibs had had no trouble understanding that particular metaphor—enjoyable, non-nutritive food being equated with ease—just as humans had no difficulty with the Ibese expression for the same sentiment, "downward slope." Communicating with aliens as big as Jupiter who might or might not be intelligent, might or might not be able to see, might or might not understand any principle of physics or mathematics, could prove impossible.

"The babble on all two hundred frequencies is continuing," said Rhombus.

Rissa nodded. "But no way to tell if it's chatter amongst the spheres, or responses aimed at us." She touched another button. "I'm going to try again

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with a loop of a different, almost-as-common darmat word."

This time, the radio cacophony was halted by one darmat who was apparently *shushing* the others. And then that darmat repeated a simple, three-word sentence over and over again.

"Time to play a hunch," said Rissa.

"How so?" asked Keith.

"Well, the first question we would ask in a circumstance such as this would be 'Who are you?' Hek and I had PHANTOM sample all the darmat words, and devise a signal that followed the apparent rules for valid word construction but had not, as far as we've been able to detect, been used by the darmats. We hope they'll take this signal to be *Starplex*'s name."

Rissa broadcast the made-up word several times—and, at last, the first breakthrough: the same sphere that had shushed the others repeated the term back at the probe.

"The rain in Spain," said Rissa, grinning, "falls mainly on the plain."

"A thousand pardons," said Rhombus. "My translator must be broken."

Rissa was still grinning. "It's not broken. It's just that I think she's got it—I think we've made contact."

Keith gestured at the display. "Which one is talking to us?"

Ropes danced on Rhombus's console. "That one," he said, as a blue halo appeared around one of the red circles. He operated his console some more. "Here, let me give you a better picture. Now that we've got the green star for light, I can get good views of the individual darmats." The red circle disappeared, replaced with a gray-on-black rendering of the sphere.

"Can you increase the contrast?" asked Keith.

"A pleasure to do so." The parts of the sphere that had been gray or smoky now showed in a much wider range of intensities, all the way through to pure white.

Keith regarded it. With the enhanced contrast, a pair of vertical white convection lines were visible going from pole to pole, flaring out at the equator. "A cat's eye," he said.

Rissa nodded. "It does look like one, doesn't it?" She touched some controls. "OK, Cat's Eye, let's see how intelligent you are." A horizontal black bar appeared floating in the holo bubble, about a meter long and fifteen centimeters tall. "That bar represents a series of fusion lamps on the probe," said Rissa. "The lamps have been turned off since the probe was deployed. Now, watch." She tapped a key on her console. The black bar turned electric pink for three seconds, went black again for three seconds, turned pink twice in rapid succession, blacked out for another three seconds, then blinked on three times. "When the bar is pink, I've got all the fusion lamps on," said Rissa. "The probe is also broadcasting white radio noise when the lights are on, and silence when they're off. I've set the bridge speakers to the frequency used by Cat's Eye."

The speakers were silent, but Keith could see indicators blinking on Rhombus's panel, showing chatter on some of the other frequencies.

Rissa waited about half a minute, then touched a key. The whole se-

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quence—one blink, two blinks, three blinks—repeated itself.

This time there was an immediate response: three darmat words, which PHANTOM translated over the speakers as three distinctive patterns of bleeps and bloops.

"Well," said Lianne, "if we're lucky, that's darmat talk for one, two, three."

"Unless," said Thor, "it's darmat for 'what the hell—?'"

Rissa smiled, and pushed the same key. The probe winked out one, two, three again, and Cat's Eye responded with the same three words. "OK," said Rissa. "Now for the real test." She pressed another key, and everyone watched as the indicator bar winked in reverse sequence: three, two, one.

The darmat responded with three words. Keith couldn't quite tell for sure, but—

"Got it!" crowed Rissa. "Those were the same three words Cat's Eye said before, but in the opposite order. He understands what we're saying—and therefore has at least a rudimentary intelligence." Rissa ran the sequence again, and this time PHANTOM substituted the English words "three, two, one," in a synthesized male voice with an old-fashioned French accent—apparently that was to be the standard for darmats.

The bridge staff was rapt as Rissa pressed on, learning the darmat words for the numerals four through one hundred. Neither she nor PHANTOM could detect any kind of repeating pattern in the word construction that would allow one to deduce the base the darmats used for counting; it seemed that each numeral was represented by a word unrelated to all the others. She stopped at one hundred, afraid the darmat would get bored by the game and cease communicating with her at all.

Next came exercises in simple math: two blinks, a six second pause—double the normal length—two more blinks, another six second pause, and then four blinks.

Cat's Eye dutifully provided the words two, two, and four each of the first five times Rissa repeated the sequence, but on the sixth, it finally caught the intended meaning of the prolonged gaps: a six second gap meant a word was missing in the middle. PHANTOM didn't wait for Rissa's confirmation; when Cat's Eye next spoke, it translated the darmat sentence as "two plus two equals four"—adding the terms for the two operators to the translation database. In short order, Rissa also elicited the darmat words for minus, multiplied by, divided by, greater than, and less than.

"I think," said Rissa, grinning from ear to ear, "that there's no doubt that we're dealing with highly intelligent beings."

Keith shook his head in wonder as Rissa continued to use mathematics to work out more vocabulary. She soon had the darmat terms for *correct* and *incorrect* (or *yes* and *no*)—which she hoped would also be their terms for right and wrong in other areas. She then had Rhombus move the probe in specific ways (carefully avoiding splashing the darmat with hot ACS exhaust), and that led to the darmat words for up, down, left,

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right in front, behind, receding, approaching, turning, tumbling, circling, fast, slow, and more.

By moving the probe in a path right around Cat's Eye, Rissa was able to get the darmat word for orbit, and soon had picked up the words for star, planet, and moon, as well.

By using colored filters on the probe's fusion lamps, Rissa then elicited the darmat words for various hues. She next broadcast her first simple original sentence, beginning with the arbitrary sign they'd originally assigned to the probe that was *Starplex*'s mouthpiece: "*Starplex* moves toward green star." Rissa then had Rhombus make the probe do precisely that.

Cat's Eye understood at once, responding with the word for "correct." He then sent his own sentence: "Cat's Eye moves away from *Starplex*," then turned word into deed. Rissa replied with "correct."

When alpha shift was over, Keith went back to his apartment to shower and eat, but Rissa kept on long into ship's night, building up a bigger and bigger vocabulary. Never once did Cat's Eye show the slightest sign of impatience or fatigue. By the time gamma shift was coming on duty, Rissa herself was exhausted, and she turned the translation duties over to Hek. They worked for four days—sixteen shifts—slowly building up a darmat vocabulary. Cat's Eye never let his attention falter. Finally, Rissa said, they could engage in a simple conversation. Keith, as director, would vet the questions, but Rissa would actually pose them.

"Ask him how long he's been here," said Keith.

Rissa leaned into the microphone stalk emerging from her console. "How long have you been here?"

The answer came quickly: "Since the time we started talking, times 100 times 100 times 100 times 100 times 100 times 100."

PHANTOM's voice came on, interpolating: "That is approximately four trillion days, or roughly ten billion years."

"Of course," said Rissa, "he could be speaking figuratively—just meaning to convey a very long time."

"Ten billion years," said Jag, "is, however, a rough approximation of the age of the Universe."

"Well, if you were ten billion years old, I suppose you'd have a lot of patience, too," said Thor, chuckling.

"Maybe ask him a different way," suggested Lianne.

"Is that how long all of you have been here?" said Rissa into the mike.

"This group that duration," said the translated voice. "This one, duration since the time we started talking, times 100 times 100 times 100 times 50."

"That translates to approximately 500,000 years," said PHANTOM.

"Perhaps he's saying this group of darmats is ten billion years old," said Rissa, "but he's only half a million himself."

"'Only,'" said Lianne.

"Now tell him how old we are," said Keith.

"You mean *Starplex*'s age?" asked Rissa. "Or the age of the Commonwealth? Or the age of our species?"

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"We're comparing civilizations, I guess," said Keith. "So the comparisons would be the oldest Commonwealth race." He looked at his little hologram of Rhombus. "That's the Ibs, who have existed in their current species form for about a million years, right?"

Rhombus's web rippled in agreement.

Rissa nodded and keyed her mike. "We duration since the time we started talking times 100 times 100 times 100 times 100. This one duration since the time we started talking times 100 *plus* 100." She touched the off switch. "I told him that as a civilization, we're a million years old, but *Starplex* itself is just two years old."

Cat's Eye replied by reiterating the number for its own personal age, followed by the word for minus, then repeating the equation for *Starplex*'s tiny age, adding the word for equals, and then reiterating the same sequence it had used to express its own age. "Very loosely," said Rissa, "I think he's saying that our age is nothing compared to his."

"Well, he's right about that," said Keith, laughing. "I wonder what it would feel like to be that old?"

CHAPTER 15

Keith rarely entered any of the ship's Ibese areas. Gravity was kept at 1.41 times Earth normal there (and 1.72 times ship's standard); Keith felt as though he weighed 115 kilograms, instead of his usual 82. He could stand it for short periods of time, but it wasn't pleasant.

The corridors here were much wider than elsewhere aboard *Starplex*, and the interdeck areas were thicker, making for lower ceilings. Keith didn't have to stoop, but he found himself doing so anyway. The air was warm and dry.

Keith came to the room he was looking for, its door marked with a matrix of yellow lights forming a rectangular shape with a small circle just below the rectangle's base at each end. Keith had never seen a train with wheels, except in a museum, but the pictogram did indeed look like a boxcar.

Keith spoke into the air. "Let her know I'm here, please, PHANTOM."

PHANTOM chirped acknowledgment, and, a moment later, presumably having received Boxcar's permission, the door slid aside.

Ib living quarters were unusual by human standards. At first, they seemed luxuriously big—the room Keith had entered measured eight by ten meters. But then one realized that they were actually the same size as every other apartment aboard ship, but weren't divided into separate sleeping, living, and bathing areas. There were no chairs or couches, of course. Nor was there any carpeting; the floor was covered with a hard rubber material. On their homeworld, in pre-industrial times, Ibs built mounds of earth just wide enough so that they would fit between their wheels, so that the frame and the other components could be supported when the wheels temporarily separated from the body. Boxcar had the manufactured equivalent of such a mound in one corner

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of her room, but that was its only furnishing.

Keith found the art on the walls strange and disconcerting: peanut-shaped images consisting of multiple, often distorted, views of the same object from different angles superimposed one atop the other. Keith couldn't make out what the ones on the far wall showed, but he was startled to realize that the series nearest to him were studies of severely premature human and Waldahud babies, with stubby limbs, and strange, translucent heads. Boxcar was a biologist, after all, and alien life was probably fascinating to her, but the choice of subject matter was unsettling, to say the least.

Boxcar rolled towards Keith from the far side of the room. It was nerve-racking to have an Ib approach from a good distance. They liked to accelerate to high speed and then stop with a jerk only a meter or two away. Keith had never heard of a human getting steamrollered by one, but he was always afraid he'd be the first.

The Ib's lights flashed. "Dr. Lansing," she said. "An unexpected pleasure. Please, please—I have no seat to offer you, but I know the gravity is too high. Feel free to rest on my comfort mound." A rope flicked in the direction of the wedge-shaped construct at the side of the room.

Keith's first thought was to reject the offer out, dammit, it was unpleasant standing under this gravity. He walked over to the mound and rested his rear on it. "Thank you," he said. He didn't know how to begin, but he knew he would offend the Ib if he wasted time coming to the point. "Rissa asked me to come to see you. She says you are going to discorporate soon."

"Dear, sweet Rissa," said Boxcar. "Her concern is touching."

Keith looked around the room, thinking. "I want you to know," he said at last, "that you don't have to go through with the discorporation—at least so long as you are aboard *Starplex*. All staff aboard this ship are considered *de facto* embassy personnel; I can try to arrange immunity for you." Keith looked at the being; he wished it had a face—wished it had normal eyes, eyes that he could try to read. "Your service has been exemplary; there's no reason why you couldn't continue to serve aboard *Starplex* for the rest of your natural life."

"You are kind, Dr. Lansing. Very kind. But I must be true to myself. Understand that though I have not mentioned my impending discorporation to anyone, I have been preparing mentally and physically for it for centuries now. I have timed the events of my life to conclude now; I wouldn't know what to do with the extra fifty years."

"You could continue your research. Who knows? With another half century of work on the senescence problem, you might lick it. You might *never* have to die."

"An eternity of shame, Dr. Lansing? An eternity of guilt? No, thank you. I am unalterably committed to my stated course of action."

Keith was quiet for a moment, thinking. Arguments and counterarguments ran through his head; new

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tacks, new approaches. But he dismissed them all. It wasn't his business, wasn't his place. Finally, he nodded. "Is there anything I can do to make it easier for you? Any special facilities or equipment you need?"

"There is a ceremony. Normally, most Ibs would not attend; to do so would be to have the guilty party end up wasting even more of their time. I imagine that only my closest Ib friends will come. So, on that basis, I have no need for a large venue. But, since you have offered, I would request, if possible, that I be allowed to use one of the docking bays for the ceremony—and that once the ceremony is completed, my component parts be ejected into space."

"If that is what you'd like, then of course you have my permission."

"Thank you, Dr. Lansing. Thank you very much."

Keith nodded, and headed for the door. He made his way down the warm corridor, back into the CAGE conditions of the central shaft. Normally, when he exited an Ibese area into the lower gravity of the rest of the ship, he felt buoyant, light as a feather.

But not this time.

"Tachyon pulse!" announced Rhombus from the ExOps station. "Something coming through the shortcut. Small object, only about a meter in diameter."

Most likely a watson, Keith though. "Let's have a look at it, Rhombus." Part of the spherical hologram was set off by a blue border, and inside the border was a telescopic view of the object that had popped out of the shortcut.

"Welcome home!" said Thor Magnor, grinning broadly.

"Somebody better get Hek and Shanu Azmi down here," said Keith.

"Will do," said Lianne, then a moment later, "They're on their way."

The port starfield split and the Waldahud alien-communications specialist waddled onto the bridge. Almost simultaneously, the door behind the seating gallery opened up, and Shahinshah Azmi came in. He was wearing tennis shorts and holding a racket. Keith gestured at the magnified image. "Look what's come back," he said.

All four of Hek's eyes went wide. "That's . . . that's wonderful!"

"Rhombus," Keith said, "scan it for anything untoward. If it's clean, use a tractor beam to haul it into docking bay six."

"Scanning . . . no obvious problems. Locking on tractor beam."

"Keep it isolated inside a force field once you get it aboard."

"Will do, with respect."

"I wish it had arrived last week," said Azmi.

"Why?" Rissa asked.

"It would have saved us all the work of building it."

Rissa laughed.

"Shanu, Hek, shall we repair to bay six?" Keith said.

"I'd like to have a look, too," said Rissa.

Keith smiled. "By all means."

The four made their way to the docking bay. There, they stood behind a force-field curtain, Hek about

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two meters to Keith's right, Azmi just behind him, and Rissa so close to her husband's left side that their elbows lightly touched. The cube was maneuvered into the bay by a series of invisible beams. Once it was set down, a force bubble was erected around it, and the space door slid down from the ceiling. They waited until the bay was pressurized, then went out to look at the cube.

It had weathered the eons well. Its surface looked as if it had been scoured with steel wool, but all the incised markings showing the sample questions on top were quite legible. It turned out that Rhombus had maneuvered the cube in so that the face with the answer was the one the cube was sitting on.

"PHANTOM," Keith said, "flip the cube a quarter turn so that the bottom face is visible."

Tractor beams manipulated the time capsule. In the space that had been left for the answer, black symbols stood out against a white background that had somehow been fused to the cube's surface.

"Gods," said Hek.

Rissa's jaw dropped.

Keith stood immobile.

At the top of the answer space was a string of Arabic numerals.

10046397-281

And beneath it, in English, was: *Pushing back the stars is necessary, and not a threat. It will benefit us all. Don't be afraid.* Underneath all that, in somewhat smaller type, it said, *Keith Lansing.*

"I don't believe this," Keith said.

"Hey, look at this," barked Hek, leaning closer. "That isn't how one makes that character, is it?"

Keith peered at it. The serif on the each lowercase "u" was on the left side of the letter instead of the right. "And the apostrophe in 'don't' is backwards, too," said Keith.

"And what's that series of numbers at the top?" asked Rissa.

"It looks like a citizenship number," Keith said.

"No—a mathematical expression," said Hek. "It is—it is—Central Computer?"

"Negative one thousand three hundred and fourteen," said PHANTOM's voice.

"No, it's not that," said Rissa, shaking her head slowly. "When humans write a letter, that's where they put the date."

"So what's the format?" asked Hek. "Hour / day / month / year? That doesn't work. How about the other way around? The tenth year, the six hundred and forty-sixth day. That makes no sense either, since they're only four hundred or so days in a Terran year."

"No," said Rissa. "No, it's not that. It's the year—the whole thing is the year. Ten billion, six hundred and forty-six million, three hundred and ninety-seven thousand, two hundred and eighty-one."

"The year?" said Hek.

"The year," said Rissa. "The Earth year. *Anno Domini*—after the birth of Christ, a prophet."

"But I've seen lots of human numbering before," said Hek. "Yes, you separate big numbers into thousands groups—my people do it into ten thousands. But I thought you used—

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what do you call them?—those subscripted curlicues?"

"Commas," said Rissa. "We do use commas, or spaces." She seemed to be having trouble keeping her balance; she moved over to the docking-bay wall and leaned against it. "But . . . but imagine a time so far in the future that English isn't used anymore . . . a time in which it's been millions or billions of years since . . ." she pointed at Keith ". . . since anyone has used English. They might indeed misremember the convention for writing big numbers, or how to make an apostrophe, or where the little extra doodad on a U went."

"It's got to be a fake," Keith said, shaking his head.

"If it is, it's a perfect one," said Azmi, waving a hand scanner. "We built some very-long-half-life radioactives into the cube's construction. The cube is now ten billion Earth years old plus or minus nine hundred million. The only way to fake that kind of dating would be to manufacture a counterfeit cube using the correct ratio of isotopes to give that apparent age. But even to the smallest detail this one matches our original—except for the radioactive decay and the surface scouring."

"But to have it signed with my name," said Keith. "Surely that's a mistake?"

"Perhaps somehow your name has come to be associated with *Starplex*," said Hek. "You are its first director, after all, and, frankly, we Waldahudin always thought you took too much of the credit. Maybe that was not a signature. Maybe it was the address, or the salutation, or—"

"No," said Rissa, eyes growing wide. Her voice was shaking with excitement. "No—it's from you."

"But . . . but that's crazy," Keith said. "There's no way I'm going to be alive ten billion years from now."

"Unless it's a relativistic effect," said Hek, "or perhaps suspended animation."

"Or. . . ." said Rissa, her voice still shaking.

Keith looked at her. "Yes?"

She started jogging out of the bay.

"Where are you going?" barked Hek.

"To find Boxcar," she shouted. "I want to tell her that our life-prolongation experiments are going to succeed beyond our wildest dreams." ■

TO BE CONTINUED IN THE NEXT ISSUE.

In scientific work, those who refuse to go beyond fact rarely get as far as fact.

—Thomas Huxley

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BOOKS ON DISK

One of the basic truths of science and technology is that every new discovery or invention has two sides. It offers us both opportunities or blessings and potential or real problems. The hype that accompanies the discovery or invention is based on the former. The protests that often also accompany the discovery or invention are based on fear of the latter; often they have a very outraged, panicked tone—think of what Jeremy Rifkin and his Foundation for Economic Trends have had to say about biological engineering, notably including genetic engineering.

The "progress is good for you" school would like to pretend that the other side does not have a point. Of course, it does, but that is not to say that we should let fear or caution—even genuinely justifiable fear or caution—paralyze us. It is far better, say those who think clearly, to recognize the problems and to cope with them. Steamboats provide a nice example, for in the early days, before their builders knew how to make strong boilers, they had a tendency to blow up, especially when their crews tied down the safety valves to get more speed in races. Lives and property were lost. But the technology was not abandoned as too hazardous; instead,

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the builders learned how to make better boilers and their crews learned that tying down safety valves was really kinda stupid.

So. We need to accept new technologies, to learn how to use them and how not to use them, to find their inevitable problems and devise ways past or around them. This is the sort of attitude you have long seen in this magazine—after all, problems make great stories—and I expect that you will therefore find a great deal to love in Nancy Kress's latest, **Oaths and Miracles**.

The tale begins in Las Vegas. A showgirl is in a sweat because her Mafia boyfriend has just been killed, and he had told her something dangerous: *"Cadoc. Verico. Cadoverico."* She tells Jeanne Cassidy, her girlfriend, and soon after the showgirl, too, is dead. FBI agent Robert Cavanaugh, whose ex doesn't think his faxes are cute anymore, investigates, but Cassidy does not share the magic words.

Now meet Ben Kozinski, an egotistical, unfaithful, hotshot genetic engineer. A biotech firm named Verico is wooing him. He visits, comes home to have an typical fight with his wife, flees the house, and is murdered.

And here's Wendell Botts, late a Soldier of the Divine Covenant, a religious sect that worships Saint Cadoc. His wife has divorced him for his drunken violence, but he knows the sect is having far too many deaths, and he wants his two kids out of there.

An FBI wiretap has picked up a hint that Verico is a Mafia operation. An eager-beaver Justice Department lawyer wants an investigation, but there is no solid evidence. Cavanaugh, intrigued, begins to poke even though he knows far less than the reader. Meanwhile, Kozinski's widow Judy, a science writer, is also asking questions.

When the Mob gets nervous, it brings out the guns. This behavior in due time assures Cavanaugh he is on the right track. He finds someone who can fill him in on the work Ben Kozinski was doing, which presumably prompted Verico to try to recruit him; the answer is ways to target viruses to specific tissues, even to specific individuals. The potentials include both a cure for cancer and a perfect assassination tool. It's a very nice example of the two faces of technology. No wonder the Mafia is interested. But there's still no evidence.

It's only a matter of time. The threads come together quite satisfyingly, and Kress has the integrity at the end to say, in effect, that the two-faced genie of genetic engineering is out of the bottle. Its blessings and curses are something that will be with us forevermore. So live with it. Cavanaugh and Judy will.

The end of the Cold War has meant something of a scramble for the US National Laboratories to avoid extinction. There's still a defense mission, of course, but it isn't what it used to be and Washington is very aware that the country cannot justify supporting so many institutions and workers with public money.

What can labs such as Lawrence Livermore do? They can devise shiny

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new high-tech projects such as inertial confinement (or laser) fusion, but that one was so expensive Congress yanked the funds in favor of magnetic confinement fusion, just before downsizing that on the grounds that it wasn't making progress fast enough. Or the labs can try to invent, do contract research, and consult for private industry, despite obstacles raised by the classification fetish long associated with defense work.

Kevin J. Anderson and Doug Beason have used the built-in tension there to good effect in **Virtual Destruction.** The tale begins in Livermore's Virtual Reality Lab, where a team of fairly typical techies, under the abrasive direction of Hal Michaelson, has developed a full-surround, three-dimensional, helmetless approach to virtual reality. It's *very* convincing, and as soon as it is clear how well it works, Michaelson is off to Washington to push it as a shiny new high-tech project, the perfect basis for on-site inspection—install a few sensors, and an inspector has a perfect view of whatever is going on.

Chief tech-nerd Gary Lesserec is less sanguine. In fact, he *knows* the scheme won't work, for it can be fooled by recordings. On the other hand, the technology he has developed for Michaelson *does* have real applications in entertainment, education, therapy, and other areas. He's even been developing such applications on the side; his consulting fees have already made him quite well off. To prove his point, he sets up a demo for Michaelson to try when he gets back from Washington.

Unfortunately, Michaelson is an arrogant SOB who is stiffing an old girlfriend, planning to replace Lesserec, and stomping on his co-director. Meanwhile, a worker in the Plutonium Facility has decided to get even with the bullies who make his life hell; he is also supplying Lesserec with unspecified "material." And when Michaelson gets back, the co-director shows him around the Plutonium Facility, they fight, and they wash their hands. Then Michaelson tries that demo and winds up dead.

Enter the FBI. Agent Craig Kreident specializes in high-tech cases, but he's at something of a loss here. He suspects Lesserec. When Michaelson turns out to have died of exposure to hydrofluoric acid and the co-director got a smaller dose, he suspects him. When the stiffed girlfriend shows up, he suspects her. And they are all—just as the reader suspects—red herrings.

There's not much detecting going on here. The tale exists to give us a tour of Livermore, explicate some interesting technology, and discuss the problems the end of the Cold War has given the national labs. This is perhaps enough for readers with a rather techie orientation—like *Analog* readers—but I suspect it isn't for the rest of the world.

Stephen Gould's first novel, *Jumper,* gave a kid an old-time SF wish (teleportation) and watched to see what he did with it. His second does much the same; the wish doesn't involve a super-power and the kid's a little older, but **Wildside** is still old-time what-if SF and the story is still a matter

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of watching the consequences.

It's high-school graduation time, and Charlie is driving his friends, Clara and Rick, Marie and Joey the idiot (Charlie has a yen for Marie, but Joey really is a jerk), to the prom. That done, he offers them summer jobs. You see, he inherited a farm from Uncle Max, who vanished a few years before—and now he has a few passenger pigeons to peddle.

That's his mistake. He doesn't have many options, since he needs money for what he has in mind, but when he offers the pigeons to zoos, he draws attention. And despite all his efforts to remain anonymous, that attention will in due time find him and his secret.

That secret is simple: In Uncle Max's barn there is a portal to an alternate Earth, one without humans, one therefore quite unspoiled and full of all the species that have died or diminished in our own world. It's also full of untouched gold deposits, and that's what he wants to get at. The idea is to use the money from the pigeons to pay for flight training for his friends, a couple of airplanes, weapons (for the sabertooths and dire wolves), and other equipment and supplies. They will then mine gold and make themselves as rich as they could ever dream.

Things proceed quite according to schedule, complicated only when Joey-the-idiot has to be dried out and set on the Twelve-Step track, and again when Rick decides he prefers another guy to Clara. And, of course, again when the attention Charlie drew at the start finally finds them.

If you read Jack McDevitt's *Ancient Shores,* you know what to expect, and you are quite right. But where McDevitt's government is pretty aboveboard about its grab, Gould's is not. We're talking covert ops here, folks. The CIA in its worst mode, descending on the farm with neither warrant nor warning.

Thereafter the story's basic thrust is how do the mice keep the cat from getting into the hole, how do the mice escape the cat, how do the mice get rid of the cat so they can continue on their merry way. In other words, good, old-fashioned excitement and reading fun, and at the end a bit of a shift in the meaning of that "merry way."

It's a nice story, well thought out and meticulously plotted. The drawback, to my mind, is that the setup stage—getting the money, the flight training, and so on—is too drawn out. The tale drags, and many readers may not hang in long enough to reach the payoff.

Allen Steele's novella **The Weight** is too short to drag, and it's nicely enough done, but it's still no page-turner. Set in the same future as Steele's novels, it centers on the voyage of the *Medici Explorer,* a deep-space shepherd for a convoy of automated freighters, from lunar orbit to Jupiter, where it will pick up a shipment of Helium-3 for Earth's fusion power plants. The narrator, Elliot Cole, is a writer collecting material for his next book (perhaps he is really Steele himself). The tale is thus quite descriptive of the ship, its procedures, and its crew—an "extended

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family" of a sort Heinlein would have liked. For drama, Steele tosses in a bit of resentment of media interest in the family's sex life, the rescue of a marooned space-wreck survivor, and an insurrection at the Helium-3 depot. The overall effect is thoughtful but light, as if Steele wasn't sure his thoughts were worth major effort. The publisher may have agreed, for a number of awkward constructions ("each [room] was a different cell in which a seedy reflection of distant Earth was reflected") and weird typos ("dawb" for "daub" for instance) survived its editorial attentions.

Steele reports, by the way, that "Miramax Films is actively interested in adapting it as a feature-length movie."

Tim Powers's **Expiration Date** is a strange and tasty item. Strange because it prompts an almost "Say what?" from the reader. Tasty because—just as we expect from Powers—it is fantasy with a difference, lacking all signs of the elves, unicorns, dragons, and wizards made *de rigueur* by Tolkien and "Dungeons and Dragons" games. There aren't any vampires, either.

But there are plenty of ghosts! We don't know that's what they are right away, but Powers doesn't leave us clueless long. The tale opens with Koot Hoomie Parganas, an eleven-year-old boy being brought up to be a holy man. Kootie isn't very pleased with the trip his folks have laid on him, nor with his name, and he is all set to run away into the wilds of Los Angeles. But first . . . the family has an icon, a bust of Dante, that he has long been forbidden to touch. He is feeling defiant. He'll show his parents! And he slams the bust on the hearth. It smashes.

Lo! and Behold! Hidden within the plaster is a little oblong wrapped in silk. Kootie removes the silk and reveals a glass brick. Unbeknownst to him, at the very moment he removes the wrapping, every psychic in the LA region jumps. Cars swerve. Ghost-eaters orient on the scene.

Ghost-eaters? Yes, for in Powers's world ghosts—known as smokes—can be trapped in palindromes, scattered puzzle pieces, arrays of loose change, and other traps. The trappers, when they have a catch, either snort it up immediately or imprison it in a glass jar (transparent, not opaque) for later use or for sale to connoisseurs. Those of kinder bent write "L.A. cigar—too tragical" around the rims of ashtrays and the like so that ghosts trapped by the palindrome will be burned up by the first touch of a glowing coal and thereby be freed.

Obviously, Kootie has a heckuva ghost, though he has no idea of the truth. He proceeds to run away and is beaten and robbed of his money. Yet he still has the brick, and he hopes that if he crawls home, his folks will forgive him. Unfortunately, when he gets home, he sees the ghosts of his parents twirling in the living room and their tortured bodies duct-taped to chairs. And there's a one-armed stranger, crying, "Kid, come here."

He is, of course, off like a scalded cat, and so's the story. Before long, Kootie finds a seam in the brick, pries it open, and inhales the ghost of

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Thomas Edison (his picture is on the book's cover, so I'm not spilling too much here). Because Kootie has not yet reached puberty, he can't absorb the ghost, so Edison rides him in and out of trouble.

What's the trouble? The one-armed stranger is Sherman Oaks, a mysterious collector and seller of ghosts who craves Edison as a prize among prizes. Kootie's own ghost will be a mere appetizer.

Others are also aware of the prize to be had, but their schemes are far more tangled. Here's Loretta DeLaraya, a fat ghost-eater who lives on the *Queen Mary* and films short subjects in locations that give her the opportunity to suck up ghosts through clove-scented cigarettes (what was that about ashtrays and lit cigarettes destroying ghosts? Don't ask for consistency). For years, she used the twins Pete and Sukie Sullivan as ghost-bait; once she was Kelley Keith, their stepmother who vanished after the drowning death of their father. Now Sukie is dead and Pete is returning to LA, drawn by the psychic flash of Edison's ghost. Here's Neal Obstadt, so power-hungry that he thinks of absorbing people the way he does ghosts. Here's a psychiatrist whose toying with seances once went spectacularly haywire.

Powers has a gift for characterization. Every one of his actors comes alive on the stage, and I include in that his Edison, whom he shows us via both memories and actions. They may be strange. They may even be as dead as Edison and Nicky Bradshaw, but they come alive, and once the reader gets past the preposterous premise, the suspension of disbelief is easy. Powers builds momentum quickly, and as the characters converge the reader gets quite engaged. This one's a winner.

On the other hand, the book does have a few elements that may make you choke quite as badly as if you had tried to absorb a ghost that had been stored in an opaque container. For one, Powers tells us that ghosts can accrue mass by absorbing litter and dust. As they gain solidity, they come to look like people. But since they are ghosts, after all, they aren't all there. In fact, they are the street people who mumble and shriek on the streets.

I suppose it would be nice if we could dismiss street people so easily. But we can't. And Powers's suggestion that we might draws a rather jaundiced snort from me. I won't dump on him any worse because this is fiction, after all, and the notion does fit neatly into the world he has created.

Overall, *Expiration Date* is a heck-uva tale. Don't miss it.

Poul Anderson's **All One Universe** is a very nice collection of stories and essays. Anderson sees, he says, the Universe as wondrously varied and unified, and SF "stories help us feel our kinship to the rest of the Universe, past, present, and future, close to home or abyssally remote, grim or grand, bleak or bright, always fascinating.

"The tales and occasional essays [here] put into human terms, as well as I am able, a little of that variety in unity."

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Who could say it better? And who could *do* it better? Anderson is a giant in the field, a skald perhaps, who sings songs that bring us all rapt into his hall, who will be remembered as long as any other giant. The material he has chosen to put in this package—ranging from 1967's "The Visitor" to 1992's Stapledonian "In Memoriam"—is quite enough to make the case.

What else do I need to say? That this is the perfect introduction to Anderson's work? That it's a perfect introduction to SF for the benighted? Consider it said.

In response to readers who have asked for more of their Liaden universe (the setting of *Agent of Change*, *Conflict of Honors*, and *Carpe Diem*), Sharon Lee and Steve Miller have brought out a chapbook, **Two Tales of Korval: Adventures in the Liaden Universe, No. 1.** Its two stories were once sold to magazines, but—much to the authors' frustration—the magazines died before the stories could see print. "To Cut an Edge" puts a young man on an alien world, assigned to prove his qualifications to become a Scout by establishing contact with the locals; after due frustration and with the aid of music and heroism, he succeeds.

The second story, "A Day at the Races," should please anyone who has fond memories of P. G. Wodehouse's Bertie Wooster and Jeeves. It isn't slapstick, but it does remind very nicely of Wodehouse's peculiarly British comedy of manners. The elderly aunt is perfectly snooty; the young men are irreverent, defiant, and effective. The butler—well, Jeeves is in fact here, though he's a robot.

The flavor's a bit young-adult, but these two stories should suit anyone with a taste for science-fiction entertainment. The stories are strong on characters, clever, humane, and smooth. They're a pleasure to read.

It's another sort of pleasure to receive SF art books in the mail, even when they're flawed. The caveat is there for **Alien Horizons: The Fantastic Art of Bob Eggleton**, which showcases an artist with a grand gift for expression and composition. Eggleton works in SF, fantasy, and horror, and his covers for books and magazines (including *Analog*) have a way of inviting their viewer into the story. Unfortunately, Paper Tiger made a poor design decision when they chose to run many of Eggleton's paintings across the gutter (the crease in the middle of the book) in such a way that important elements of the paintings are lost.

If you buy art books less for the art than for what you can learn about the artist, Nigel Suckling may please you too. He has assembled descriptions and interviews to forge a concise portrait of Eggleton and his work. He does not, however, spend much time on how Eggleton works; artists who may wish to imitate will thus be disappointed.

BOOKS ON DISK

Issue 21 of *The Electronic Publishing Forum* ($6; $12 for four issues from Serendipity Systems, P. O. Box

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140, San Simeon, CA 93452) has several items of potential interest. A list of Mark Owing's offerings of classic SF includes "The Fairy Tree of Bourlemont," a short story by Mark Twain. There's a copy of the pre-World-Wide-Web-hype "Big Dummy's Guide to the Internet" (copyright Electronic Frontier Foundation 1993), covering history and basics well enough to form a nice introduction to cyberspace. And for those of you who might be a bit paranoid about electronic privacy, there's a copy of the "Pretty Good Privacy" encryption program, which is good enough to have given the National Security Agency fits.

There's even an amusing satire of "Sex on the Internet," which forces me to compare this EPF to a June bride's outfit (this may be the August column, but you're surely reading it in June): "Something old, something new, something borrowed, something blue."

Have fun! ■

IN TIMES TO COME

Bob Eggleton's September cover takes us to the world of Grey Rollins's novelette "Something on My Mind." Explorers have always expected to face new dangers, but usually, at least in recent times, could comfort themselves with the knowledge that even the new dangers had to follow old, well-known principles. But do we really know *all* the principles, or might nature still have a few surprises up its sleeve? And if we did find a place where a new one played an important role, would that make all the old knowledge useless?

Our second novelette introduces Ned Farrar, a new writer with a double-pronged idea about how a new world might best be exploited—and a cautionary reminder about the very basic problem of deciding what problem to work on.

Duncan Lunan's science fact article, "Children from the Sky," is a bit unusual. Its facts are some rather cryptic historical records scattered through old British archives, giving several views of the same set of events that no one at the time quite understood. We won't claim Lunan *necessarily* has all the answers, but he certainly does have an intriguing hypothesis with a plausible scientific basis. . . .

We also have, of course, Part 3 of Robert J. Sawyer's ever-expanding novel *Starplex,* and the return after too long an absence of storyteller Laurence M. Janifer and his unique creation, Gerald Knave, Survivor.

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BRASS TACKS

Dear Dr. Schmidt,

As I began reading "Higher Education" by Jerry Pournelle and Charles Sheffield (Feb 1996 *Analog*) I felt a slight twinge of déjà-vu. Four pages in, the feeling grew so strong that I had to put down the magazine and hunt around my bookshelves to satisfy myself.

Sure enough, I found it, in a book entitled *Future Quartet,* a four-part anthology of essays and novellas concerning what the world might be like in the year 2042. (Avon Books, 1994, ISBN 0-380-71886-3.) There it was, *Higher Education* by Pournelle and Sheffield. It looked like the same story, word for word.

After further comparison, I noticed that the story in *Analog* contains some additional material compared to the one I originally read. I'm interested to see how the story develops, or if it diverges from the original, but a question occurs to me: Is it normal practice for *Analog* to publish previously-printed work (modified or not)? Or did this one slip by accidentally?

On the whole, count me as a satisfied customer. Keep up the good work.

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No, we do not normally publish work that has already appeared elsewhere—but, as you've already discovered if you read all of Higher Education, *this is far more than just a modified version of the short story. A better way to look at it is that the short story was the seed from which the novel grew. Only the first part of the novel corresponds in any way to the short, while the bulk of it is the continuation and completion of the story.*

Dear Sir:

With respect to the SETI article in the February 1996 issue, perhaps the 1.4GHz band is not the only or perhaps even the best place to search for signals indicating extra-terrestrial intelligence.

To the extent my memory serves me, the journal *Science* contained an article 15 or 20 years ago concerning what electromagnetic signals from Earth might be detectable at the nearer stars. The two candidates were the carriers of TV stations and some high powered military radars.

I have not been able to locate this article in my local library, but to someone with access to better indexing systems it should not be difficult.

The anticipated signals around

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1.4GHz are either spillover from deliberate interstellar communications or the result of attempts at deliberate interstellar communications. Perhaps we should also listen in the 50-250 MHz band where powerful signals may exist regardless of the ETI's interest in interstellar communications!

I started reading *Astounding* in the early '40s and became a subscriber once I had a reasonably permanent address and continue as a subscriber to this day. On only one other occasion have I felt an urge to write: with the publication of the story "Eifelheim" in the November 1986 issue. Wrote to say "get an arm lock on this author." But I decided to check some back issues and found that Flynn had indeed been published previously, and while his stories were generally good none stood out to me like "Eifelheim."

ALBERT E. WELLER, JR.
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Dear Mr. Schmidt:

I would like to respond to your Science Fact article of February 1996 by Dr. H. Paul Shuch, "SETI Made Simple: What Can *We* Do?" Dr. Shuch proposes that amateurs search the sky for artificial electromagnetic (EM) radiation.

I am a mild skeptic about SETI, but I am willing to be convinced. I would like to pose three questions:

1. We have tried to determine if other stars have planets around them, because there might be life on those planets. If we ignore the obvious (reflected light from our own planets or partial occultation of the Sun by the planets) can we detect if *our* Sun has planets from here on Earth?

2. If an alien had a radiotelescope with the combined energy gathering power of every radiotelescope on Earth, at what distance from the Earth could he first detect our own EM radiation? As far away as the nearest star?

3. If all the power reasonably possible were beamed from a radiotelescope (e.g. Arecibo) at the nearest Sunlike star, would beings on a planet around the star be able to detect the signal using that same radiotelescope?

If the answer is no to any of these questions, it probably reduces the likelihood that any SETI will be successful.

I do feel that the process of using the people to do the search is much better than trying to get government to do it, and I applaud the efforts of the SETI League.

DOUGLASS J. OHMEN
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The author replies. . . .

Reader Ohmen is to be commended for his insightful questions about the Search for Extra-Terrestrial Intelligence. His mild skepticism is quite healthy, and is in fact the attitude adopted by most SETI professionals. The short answer to the three questions he poses is "yes, quite easily." But this requires some elaboration.

(1) *Can we detect other planets from Earth?* If you view our Sun against the background of stars, its position appears to wobble over time. This periodicity in its proper motion is due to the gravitational effects of Jupiter and assorted debris (including

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ourselves). A precise measurement of the wobble can be Fourier analyzed into our Sun's retinue of planets. In fact, this is how the outer planets were discovered: the Sun's proper motion indicated that more planets than those known to the ancients should be there, and told astronomers where to look.

Very recently (in fact, after my article went to press), a similar technique has been applied to a few of our neighboring stars. By measuring a star's instantaneous relative velocity (through determining how its spectrum is Doppler shifted) and plotting velocity over months or years of time, a sinusoidal pattern emerges, which can be Fourier analyzed into planetary orbits. The first conclusive discovery of an extra-solar planet around a Sunlike (G2) star was announced in early October of 1995 by Michel Mayor and Dieder Queloz of the Geneva Observatory, and independently confirmed by Geoff Marcy and Paul Butler of the Lick Observatory in California just two weeks later. The planet found orbiting 51 Pegasi (a solar twin just 42 light-years distant) has been described as an iron-nickel bowling ball about half the mass of Jupiter. It orbits very close to its star, has a surface temperature of about 1,000°C, and is thus not a particularly good place for ET to call home.

In January 1996, Marcy and Butler announced the detection of two more extra-solar planets, also orbiting nearby Sunlike stars. The planet around 47 Ursa Majoris appears to have a highly elliptical orbit, bringing it too close to its star during perihelion, and too far at aphelion, to be a likely life site. However, 70 Virginis seems to have a planet in its habitable zone, with a surface temperature around 80°C. This raises the question of the possible existence of liquid water. Though perhaps not essential to the development of life, oceans would certainly simplify the process.

The first extra-solar planets discovered (and all in the past few months!) are of roughly Jovian size. Instrumentation has improved to the point where we now expect to see planets on the scale of Saturn. We're not yet able to detect Terran planets, but in view of recent advances, we have reason to expect such discoveries early in the new century.

(2) *Could Earth's electromagnetic leakage be detected as far away as the nearest star?* For the past half-century, Earth has been radiating rather strong VHF, UHF, and microwave signals into space. Link analysis tells us that, utilizing a receiving system such as the Arecibo radiotelescope, these signals are of sufficient strength to be detectable out to perhaps 400 light-years. Within that range there exist maybe 100,000 stars, of which at least 10% resemble our Sun. We have good reason to expect (see #1 above) that maybe 1% of those Sunlike stars has a planet orbiting in its habitable zone. So there's at least a fighting chance that our incidental radiation will be detected.

Of course, we've only been radiating significant RF power for about 50 years, so at present our sphere of detectability extends only to 50 LY. This reduces our number of candidate

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stars to about 1,000, maybe 100 of which are Sun-like, and only one of which (say, 70 Virginis) is likely to have a biocompatible planet. So there's a good chance we haven't been heard yet!

(3) *Could our own receive technology hear our own transmit technology at interstellar distances?* It has been widely reported that Arecibo, our planet's largest radiotelescope, could detect its theoretical twin across the Galaxy. I must confess that I have recently tarnished my reputation in the astrophysical community, by taking issue with what I call the Arecibo Myth. The trans-Galactic range computation is numerically valid if you accept certain basic operating assumptions which, quite frankly, I must question. Most problematical for me are the receiver bandwidths in the milliHertz, and integration times in the thousands of seconds, assumed by those who ascribe to Arecibo trans-Galactic capabilities. In digital communications terms, the prevalent assumptions limit data rates to a few microBaud. I doubt that any but a race of immortal communications engineers would seriously consider investing in such a facility.

My personal computations[1] are based upon rather more conservative assumptions, and suggest a much more modest range between two Arecibos, on the order of 10,000 LY. Encouragingly, this range encompasses some 50 million stars, maybe 5 million good suns, and let us suppose 50,000 biocompatible planets. It is numbers like these which encourage me to pursue SETI, not only lacking public funding, but even in the face of outright government opposition. I hope others (maybe even Mr. Ohmen) will be encouraged to join our quest.

H. Paul Shuch, Ph.D.
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[1] Shuch, H. P., "Optical SETI and the Arecibo Myth," in Proceedings of the 2nd International Symposium on Optical SETI, San Jose CA, SPIE, February 1996.

Dear Dr. Schmidt:

I am writing in response to your editorial, "By Bread Alone," from the February 1996 issue of *Analog*.

Have you considered that overpopulation might be an actual physical impossibility past a certain point, perhaps far below the levels considered in your editorial?

The more complicated something is, the more there is that can go wrong—this seems to have been considered in your editorial.

I might also suggest that the more human brain matter that exists, the more likely problems are to be solved.

It comes down to a matter of math. It might take one human fifty years to work out a design for a city, or a staff of thousands only a few months.

Might overcrowding limit itself simply because there is more available human thought to consider the problem, thus causing a situation where the worse the problem gets, the more likely it is to be solved?

Kevin Levites

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Breeding as many people as possible, with the vague hope that enough of them thinking together will be able to figure out how to prevent that, seems to me an act of grossly misplaced faith.

Dear *Analog,*

I am glad to see that your magazine now accepts e-mail for responses. Many magazines believe that it's too informal, but then eventually we get past barriers into new technologies.

"An Ever-Reddening Glow" by David Brin (February 1996) has a message that is strikingly true. This message points out one of humanity's greatest flaws—that individual concerns precedes society's concerns. It is even more important that we realize this today, when our mistakes of the past and of the present will have a profound effect on us in the future. Every individual must realize that his own actions affect us all globally. Thanks to David Brin for sending this message to all our readers.

PETER CARBONETTO
petersca@post.queensu.ca

Dear Stan:

I presume that David Brin wrote "An Ever-Reddening Glow" with tongue in cheek—or he knows more about the expansion of the Universe than anyone else.

In the story, the universal expansion is said to be making the distances between stars in the Milky Way grow larger and larger. But as far as I know, the gravitational attraction of the stars within the Milky Way is stronger than the expansion force, and the stars in our Galaxy are not growing more distant with time. Indeed, the galaxies in our Local Group are not affected by the universal expansion, nor are the galaxies in larger clusters. Gravity keeps them bound together, despite the expansion. Clusters and superclusters of galaxies are moving apart, but not the stars within individual galaxies.

It was a good story, nonetheless!

BEN BOVA

Dear *Analog,*

Americans had better wake up because our Patent Commissioner is being outsmarted by multinational corporate interests and the Japanese, who are trying to alter our patent system for their benefit. American ingenuity has always been the fuel of our economic success and loss of patent protection will doom our citizens to a long and painful economic decline.

As a reader of this publication you are likely to understand the importance of innovation better then the average American. You can help. Contact the Alliance for American Innovation in Washington, DC at (202) 293-1414 for more information. Also contact your federal representatives and ask that they support HR. 359 and that they oppose HR. 1659, HR. 1732, HR. 1733.

RONALD J. RILEY
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Advisory Board President
Alliance for American Innovation
1100 Connecticut Ave NW
Washington, DC 20036-4101 ■

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UPCOMING EVENTS Anthony Lewis

26–28 July

CONFLUENCE '96 (Western Pennsylvania SF conference) at Sheraton Inn, Mars, PA. Guest of Honor—Michael Swanwick. Registration: $20 until 30 June, $28 thereafter. Info: ConFluence '96, Box 3681, Pittsburgh, PA 15230-3681. (412) 344-0236. Web site: http://www.lm.com/~lmann/fan/confluence96.html

2–4 August

DIVERSICON 4 (St. Paul area SF conference) at St. Paul, MN. Guest of Honor—Maureen McHugh. Registration: $20. Info: Diversicon, Box 8036, Minneapolis, MN 55408. (612) 822-8303. E-mail: 75257.2607@compuserve.com

9–11 August

RIVERCON 21 (Louisville, KY area SF conference) at Executive West, Louisville, KY. Guest of Honor—Nancy Kress, Fan Guest of Honor—Annette Carrico; TM—Allen Steele. Registration: $25 in advance, $35 at the door. Info: Box 58009, Louisville, KY 40268. (502) 448-6562. E-mail: raroch01@ulkyvm.louisville.edu

29 August–2 September

L.A.CON III (54th World Science Fiction Convention) at Convention Center, Hilton, and Marriott Hotels, Anaheim, CA. Guest of Honor—James White; Media Guest of Honor—Roger Corman; Fan Guests of Honor—Takumi and Sachiko Shibano; Special Guest [in memoriam]—Elsie Wollheim; TM—Connie Willis. Registration: $130 until 15 July 1996; higher at the door. Child-in-tow (3-12 years old in 1996): $35; infants: free. Supporting: $30. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info: L.A.Con III, c/o SCIFI, Box 8442, Van Nuys, CA 91409. E-mail: lacon3info@netcom.com

Convention runners: If your convention has a telephone, FAX, E-mail, or Web page, please let us know so that we can publish this information.

Convention attenders: When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an IRC if the convention is in a different country. ■

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HJAF6

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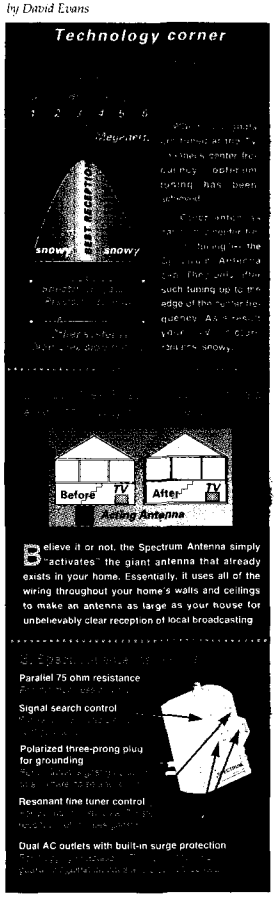
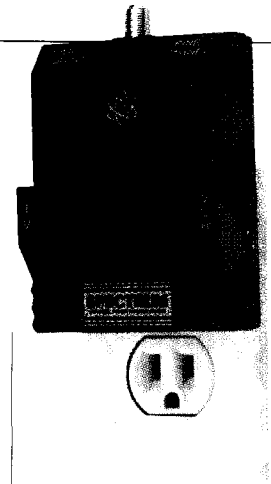
Fifteen years of microelectronic research makes conventional antennas a thing of the past!

This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better TV reception on your local broadcast networks!

by David Evans



Believe it or not, the Spectrum Antenna simply "activates" the giant antenna that already exists in your home. Essentially, it uses all of the wiring throughout your home's walls and ceilings to make an antenna as large as your house for unbelievably clear reception of local broadcasting



Until recently, the only convenient way to guarantee great TV reception was to have cable installed or place an antenna on top of your TV. But who wants to pay a monthly cable fee just to get clear reception, or have rabbit-ear antennas that just don't work on all stations? Some people just aren't interested in subscribing to cable. Or they may live in an area where they can't get cable and TV-top antennas aren't powerful enough. And what about those people who have cable or satellite systems but still can't get certain local stations in clearly?

Now, thanks to fifteen years of microelectronics research, a new device has been developed that is so advanced, it actually makes conventional antennas a thing of the past. It's called the Spectrum Universal Antenna/Tuner.

Advanced technology. Just imagine watching TV and seeing a picture so clear that you'd almost swear you were there live. Just plug the Spectrum Antenna into a standard AC outlet and plug your TV into the Spectrum. You can remove the unsightly clutter of traditional TV-top devices gathering more dust than television signals. Get ready for great reception. Your TV will suddenly display a sharp, focused picture thanks to its advanced design "Signal Search" and "Fine Tuner" controls.

Who can use Spectrum?

- *Cable users-You have cable but you can't get certain local stations in clearly.*
- *Non-cable users-You don't have cable and want the stations to come in more clearly*
- *Satellite users-You have a digital satellite system but can't get local stations in clearly*

Uses your home's electrical wiring. The Spectrum Antenna is a highly sophisticated electronic device that connects into a standard wall outlet. The outlet interfaces the Spectrum Antenna with the huge antenna that is your home wiring network. It takes the electrical wiring in your house or apartment and turns it into a multi-tunable, giant TV reception station which will improve your TV's overall tuning capability. The results are incredible. Just think how much power runs through your home's AC wiring system—all that power will be used to receive your local broadcasting signals.

How it works. Broadcast TV signals are sent out from the local broadcast station (ABC, CBS, NBC, etc.). They interface with your home's AC power line system, a huge aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna interfaces with the AC line, the signal is sent to its signal processing circuit. It then processes and separates the signal into 12 of the best antenna configurations. These specially processed signals route themselves into 12 separate circuits. The Spectrum Antenna includes a 12-position rotary tapping switch, the "Signal Switch" control, which gathers twelve of the best antenna configurations.

The "Signal Search" offers varying antenna configurations for the user to select from the best signals of all those being sent. The signal then passes through the Spectrum Antenna's special "Fine Tuner" circuit for producing crisp, clear reception.

Risk-free offer. The Spectrum Universal Antenna/Tuner comes with our exclusive 90-day risk-free home trial and a 90-day manufacturer's warranty. Try it, and if you're not satisfied, return it for a full "No Questions Asked" refund.

Limited time offer! We realize that most people have more than one TV in their home. We are offering a special discount on additional Spectrum Antennas so you get great reception on all your TVs!

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